

**The psychosocial outcome of anoxic brain injury following
cardiac arrest**

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Thesis abstract

Aim of the study

The psychosocial outcome of anoxic brain injury following cardiac arrest is a relatively under researched, but clinically important area. The aim of the current study was to add to the limited existing literature exploring the psychosocial outcome for cardiac arrest survivors, but specifically explore if there is a greater impact on psychosocial outcome in individuals experiencing anoxic brain injury as a result.

Methods

A range of self report measures were used to compare the quality of life, social functioning and symptoms of anxiety, depression and post traumatic stress of individuals with and without anoxic brain injury following cardiac arrest. Measures of subjective memory and executive difficulties were also used to investigate whether psychosocial difficulties were associated with subjective cognitive difficulties. Participants took part in the study between six months and four years post cardiac arrest. A MANOVA was used as a primary method of analysis.

Results

There was a significant multivariate difference between the two groups; with individuals with anoxia reporting more psychosocial difficulties than the non-anoxia group. Participants in the anoxia group had more social functioning difficulties and more anxiety, depression and post traumatic stress symptoms. There was no significant difference in self-reported quality of life between the two groups, although better quality of life was associated with better social functioning and fewer anxiety, depression and post traumatic stress symptoms. Although there was no significant difference between the two groups in regard to self-reported cognitive difficulties, fewer reported difficulties were also significantly associated with better quality of life, better

social functioning and fewer anxiety, depression and post traumatic stress symptoms. There was no significant association with psychosocial outcome and time since cardiac arrest and no significant gender differences.

Conclusion

As the first known study to compare outcome for cardiac arrest survivors with anoxia with those without, the results suggest psychosocial outcome is worse for individuals with anoxia. Individuals with anoxia experience significantly more social functioning difficulties and symptoms of anxiety, depression and post traumatic stress. It is suggested that the difference is due to a combination of neuropsychological, social and psychological factors resulting from anoxic brain injury following cardiac arrest, however further research is required to explore the contributing factors in more depth.

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Statement of Contribution

Project design

The project was designed collaboratively by Michelle Wilson, Dr Patrick Vesey, Consultant Clinical Neuropsychologist and Dr Andrew Staniforth, Consultant Cardiologist with advice from Dr Roshan das Nair, Research tutor

Applying for ethical approval

Michelle Wilson

Writing the literature review

Michelle Wilson with support from Dr Roshan das Nair, Dr Patrick Vesey and Dr Andrew Staniforth

Recruiting participants

Potential participants were identified by Dr Andrew Staniforth and Dr Richard Till, who then sent the participant information sheet and questionnaires prepared by Michelle Wilson

Data Collection

Michelle Wilson scored the returned questionnaires, clinical information was provided by Dr Andrew Staniforth and Dr Richard Till

Data Analysis

Michelle Wilson, with advice from Dr Roshan das Nair

Write up

Michelle Wilson

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Systematic review

The psychosocial outcome of anoxic brain injury following cardiac arrest: A systematic review¹

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Abstract

Objective

The aim of this review was to examine the psychosocial outcomes of anoxic brain injury as a result of cardiac arrest.

Method

A systematic review of Medline, PsychINFO, Embase and Web of Science databases, and a hand-search of reference lists was used to identify relevant articles. Broad criteria were used to include studies with participants who had experienced anoxia following out-of-hospital cardiac arrest and articles written in the English language.

Results

Seven studies were included for in the review. A synthesis of the results from individual studies indicated that the living situation of participants were altered following cardiac arrest with many individuals requiring support from others, and many being unable to return to their previous level of employment. Quality of life and participation in society was reduced and participants were found to be dependent on others in a number of activities of daily living. Symptoms of anxiety, depression and post traumatic stress were also identified.

¹ Prepared for submission to Resuscitation

Conclusion

The psychosocial impact of anoxic brain injury following cardiac arrest remains a relatively under-researched area. The limited research to date has identified that individuals who experience anoxia following cardiac arrest experience a range of psychosocial difficulties. A greater understanding of these difficulties would enable appropriate support to be offered for this population and assist in the decisions that medical professionals have to make when resuscitating individuals.

Introduction

A large number of cardiac arrests occur each year and as medical interventions advance, the number of people surviving cardiac arrest is increasing.¹ Because of arrested breathing during a cardiac arrest, oxygen levels to the brain may be significantly reduced or stopped. A lack of oxygen to the brain for as little as a few minutes can result in anoxic brain injury (ABI). ABI, due to cardiac arrest or other cause, has been less researched than other types of brain injury such as traumatic brain injury or stroke and therefore less is known about the outcome of such injury.

The structural damage to the brain can vary and the cerebral cortex, hippocampus, cerebellum and basal ganglia have been identified as areas that are particularly susceptible to ABI.² The psychological research that has investigated the outcome of ABI has concentrated on the cognitive outcomes and has identified that impairment in memory, attention and executive functioning are common. Systematic reviews have been published in this area,^{3,4} however much less research has explored the psychosocial outcomes and no systematic reviews of this have been previously published.

The term 'psychosocial' is used to describe a broad range of psychological and social functions, and such outcomes have been widely investigated in health conditions including neurological and cardiac disorders. Measures of social functioning often include participation in society, activities of daily living (ADL) and quality of life (QOL).⁵ Psychological functioning is generally assessed by measuring symptoms of psychological distress such as symptoms of anxiety, depression and post traumatic stress.⁶

From the limited amount of research investigating the psychosocial outcome of anoxia, findings suggest some similarities with traumatic brain injury (TBI) outcomes.⁷ It has also been widely documented in the broader research that individuals with chronic health conditions, including cardiac diagnoses, often experience psychological distress.⁸

Previous research has indicated that high levels of psychological distress are often a consequence of cardiac arrest with particular reference to incidence of anxiety and depression.^{9,10} O'Reilly et al.⁹ compared individuals who had suffered in-hospital cardiac arrest with individuals who had suffered a myocardial infarction (MI) and found that 30% of the cardiac arrest victims reported clinical levels of anxiety, compared to 7% of those with MI (although this was not a statistically significant difference) and 15% reported clinical levels of depression compared to none of the comparison group, which was a statistically significant difference.

Experiencing a cardiac arrest, particularly out of hospital, is recognised as a significant event that can lead to a response which meets the Diagnostic and Statistical Manual of mental disorders¹¹ criteria for post traumatic stress disorder (PTSD). Some researchers have found that individuals who have suffered cardiac arrest do experience PTSD symptoms. In their study, O'Reilly et al.⁹ found 19% of the cardiac arrest survivors and 7% of the MI survivors met diagnostic criteria for PTSD.

Research has suggested that psychological distress can also impact on an individual's health condition, for example Shalev, Schreiber, Galai, and Melmed¹² found that PTSD in individuals with medical conditions was associated with distress and disability and resulted in avoidance of care and poor treatment adherence. Research has also identified that depression can increase the risk of future cardiac incidents and mortality.^{13,14} It is therefore important to gain an understanding of the psychological impact of cardiac conditions, including cardiac arrest, in order to ensure adequate support is offered to survivors. Individuals who suffer ABI as a result of cardiac arrest may also experience cognitive difficulties which could impact on the psychosocial outcomes and influence the support they require. This is particularly important due to the increasing population of cardiac arrest survivors.

The aim of the current review was to examine the psychosocial outcomes of ABI following cardiac arrest. The psychosocial functions included in the

review were measures of psychological distress (such as symptoms of anxiety, depression and PTSD) and measures of social functioning (such as participation in society, ADL and QOL). Information regarding the current living situation was included in the review as this information may indicate if patients can live independently or whether they are dependent on others. Information about the employment status was also included as this may indicate if individuals were able to return to their usual roles and activities. Return to employment has also been used in previous studies as an objective measure of an individual's QOL.¹⁵

Method

Searching and selection

A computerised search of Medline, PsychINFO, Embase and Web of Science databases was performed. The search strategy was devised by identifying alternative terms for the three concepts of the research question; 'psychosocial', 'anoxic brain injury' and 'cardiac arrest'. The relevant terms identified for each concept were exploded and modified as appropriate for each database (see Appendix 1 for search terms used).

A hand search was conducted using the reference lists of the articles identified and by electronically searching the journals in which the studies identified had been published. A search of grey literature and e-theses was also conducted using the GreyNet website and the British Library catalogue.

After duplicate articles were removed, potentially relevant articles were identified by screening the titles. The abstracts of these, along with the abstracts of any ambiguously titled articles were then reviewed by one reviewer against the inclusion and exclusion criteria. This process was continued for the full text articles which were then obtained for the studies identified as appropriate from the abstract. Another reviewer checked the papers included and excluded against this criteria to prevent bias.

Inclusion criteria

Studies included were those with participants who had experienced anoxia following out-of-hospital cardiac arrest. Only articles written in the English language were included.

Exclusion criteria

Single case studies were excluded from the current systematic review. Papers that did not explicitly state or make clear whether the participants had experienced anoxia following cardiac arrest were also excluded from the review.

Data abstraction

Only findings related to psychosocial factors, as defined previously, were included in this review. The following information was gathered from each study: country where the study was conducted; what, if any, comparison group was included; number of participants (by group, if relevant); age, gender, and other participant demographics; the time between cardiac arrest and follow up for the study; the psychosocial factors investigated; the measures used; and the findings of the study. Information about the current living situation and employment status of participants was also abstracted from the articles and included in this review, as they have previously been used as objective measures of QOL.

Assessment of methodological quality

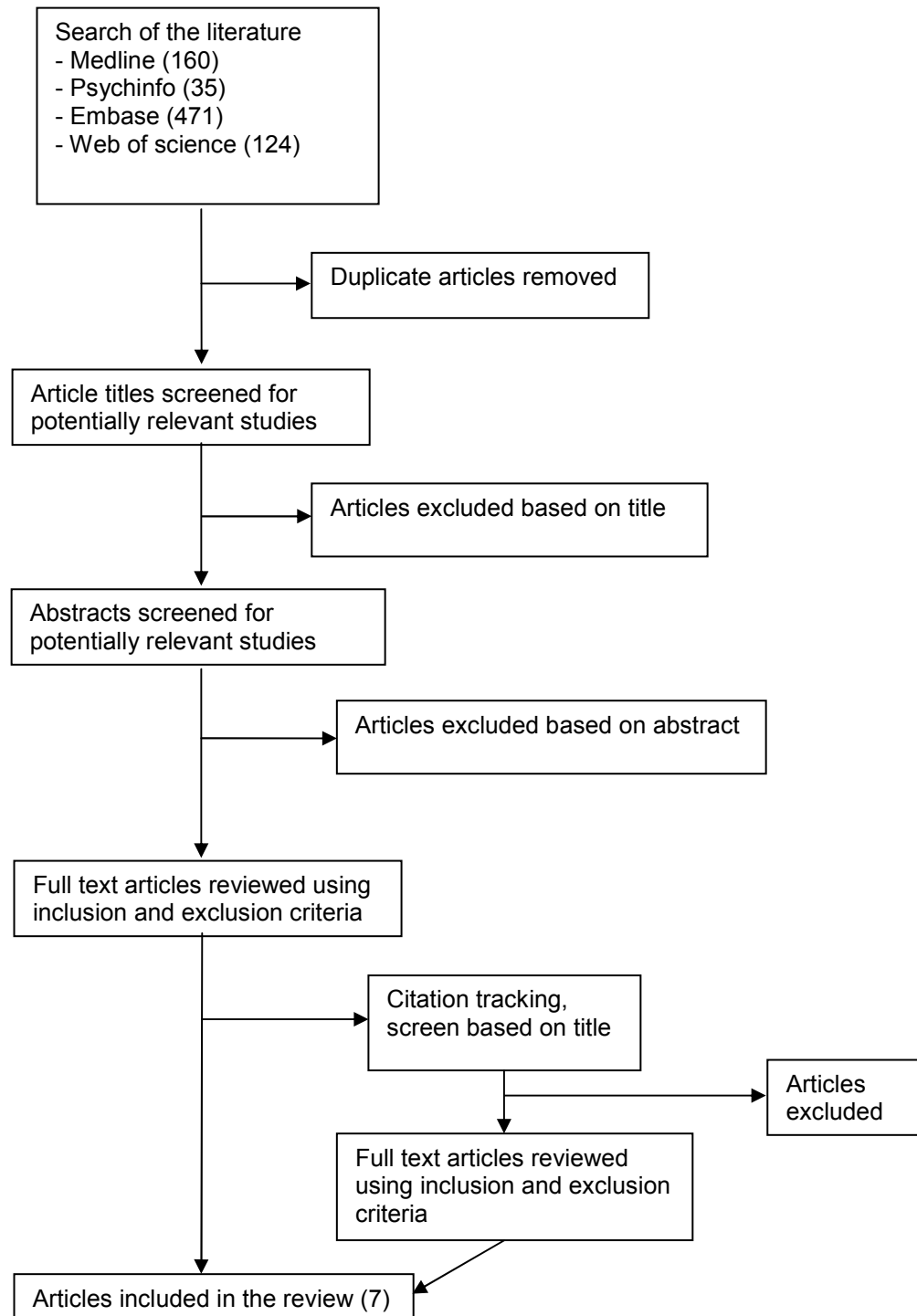
The majority of the scales and checklists to assess methodological quality of studies included in systematic reviews, are designed for use with randomised controlled trials and would therefore be of little relevance to the present review. Although scales are simple to use for these purposes, the Cochrane Collaboration Guidelines advise against using a scale which derives a score as they are not empirically relevant.¹⁶ Checklists are useful as they allow the studies to be appraised in a standardised manner and the Centre for Reviews and Dissemination suggest that these can be adapted to

suit the methodology of the studies being assessed.¹⁷ Therefore, the methodological quality of the studies included in the current review was assessed by the lead author, and verified by a second author, using a tool adapted from existing checklists including the Agency for Healthcare Research and Quality¹⁸ and Downs and Black.¹⁹

Results

A total of seven articles were identified as meeting the inclusion criteria and were included in this systematic review (see Figure 1).

Figure 1: Flowchart of the process of the identification of relevant articles



General characteristics

The studies identified included measures of a range of psychosocial functions; these included QOL, participation in society, ADL and symptoms of anxiety, depression and PTSD. The living situation and employment status of participants were also explored in some of the studies reviewed.

The general characteristics and the psychosocial factors explored in each study can be seen in table 1.

Table 1: General characteristics of the reviewed studies

Study	Authors	Publication year	Country	Mean age (Range)	Comparison group	N (Gender)	Time since cardiac arrest	Psychosocial outcome and measures used
1	Pußwald, Fertl, Faltl & Auff ²⁰	2000	Austria	51 years (17-75)	None	12 (10 male, 2 female)	7-98 months	Activities of daily living (ADL) <ul style="list-style-type: none"> Self-report rating of Activities of Daily Living Information regarding living situation Information regarding employment status
2	Middelkamp, Moolaert, Verbunt, Heugten, Bakx & Wade ⁵	2007	The Netherlands	50 years (17-64)	None	32 (19 male, 13 female)	2-7 years	Level of activities in daily life <ul style="list-style-type: none"> Frenchay Activities Index (FAI)²¹ Participation in society <ul style="list-style-type: none"> Impact on Participation and Autonomy Questionnaire (IPAQ)²² Quality of life (QOL) <ul style="list-style-type: none"> Quality of Life after Brain Injury (QOLIBRI)²³ Information regarding living situation
3	Cronberg, Lilja, Rundgren, Friberg & Widner ²⁴	2009	Sweden	62.4 years (18-85)	None	43 (34 male, 9 female)	Mean 7.2 months	Anxiety and depression symptoms <ul style="list-style-type: none"> Hospital Anxiety and Depression Scale (HADS)²⁵ Montgomery and Astrand Depression Rating Scale (MADRS-S)²⁶ Information regarding living situation Information regarding employment status
4	Wacheider, Moolaert, Heugten, Verbunt, Bekkers & Wade ²⁷	2009	The Netherlands	60 years (20-85)	None	63 (54 male, 9 female)	Mean 36 months	Anxiety and depression symptoms <ul style="list-style-type: none"> Hospital Anxiety and Depression Scale (HADS)²⁵ Post traumatic stress reactions <ul style="list-style-type: none"> Impact of Events Scale (IES)²⁸ Daily functioning <ul style="list-style-type: none"> Frenchay Activities Index (FAI)²¹ The Barthel Index²⁹ Participation in society <ul style="list-style-type: none"> The Community Integration Questionnaire (CIQ)³⁰ Quality of life <ul style="list-style-type: none"> Short Form Health Survey (SF 36)³¹ Information regarding living situation Information regarding employment status

Study	Authors	Publication year	Country	Mean age (Range)	Comparison group	N (Gender)	Time since cardiac arrest	Psychosocial outcome and measures used
5	Sunnerhagen, Johansson, Herlitz & Grimby ³²	1996	Sweden	58.6 years (19-75)	None	26 (not stated)	Mean 25.5 months	Quality of life <ul style="list-style-type: none"> Nottingham Health Profile (NHP)³³ Activities of daily living <ul style="list-style-type: none"> Personal ADL (P-ADL)³⁴ Instrumental ADL (I-ADL)³⁴ Information regarding living situation Information regarding employment status
7	Saner, Rodriguez, Kummer-Bangerfer, Schuppel & Von Planta ³⁷	2002	Switzerland	60.3 years	Healthy matched controls	50 (40 male, 10 female)	Mean 31.7 months 5-68 months	Quality of life <ul style="list-style-type: none"> The Everyday-Life Questionnaire³⁸ The Nottingham Health Profile³³ Psychological well-being <ul style="list-style-type: none"> The Psychological General well-being Index³⁹

Methodological characteristics

The assessment of the methodological characteristics of the studies can be seen in table 2. A main limitation of the studies reviewed was that only one⁷ included a comparison group. The appropriateness of the comparison group included in this study, however, could also be questioned as a sample of the general population was used rather than individuals with a similar health condition (e.g. cardiac arrest without anoxia), therefore the experience of cardiac arrest and ABI were variables specific to the cardiac arrest group.

The inclusion and exclusion criteria of the studies were also taken into account when assessing the methodological characteristics of the studies. One study³⁷ excluded individuals with severe ABI which may have excluded a large number of individuals from the population and in particular potentially excluded individuals who experience psychosocial difficulties as a result of the anoxia. Cronberg et al.²⁴ stated the inclusion and exclusion criteria used in their study, however these appeared to be based on the individuals identified rather than any a priori defined criteria.

The psychometric properties and appropriateness of the measures included in the studies were also considered. These will be discussed in the results section of this review.

Table 2: Methodological characteristics of the studies

	Study 1	Study 2	Study 3	Study 4	Study 5	Study 6	Study 7
Characteristics of participants clearly described?	Yes (Age, gender)	Yes (Gender, mean and range of age, clinical information)	Yes (Gender, mean and range of age, clinical information)	Yes (Gender, mean and range of age, clinical information)	Yes (mean and range of age, limited clinical information)	Yes (Gender, mean and range of age, clinical information)	Yes (Gender, mean and range of age, clinical information)
Any potential biases?	Yes. All participants from same rehabilitation hospital	Yes. All participants from same rehabilitation hospital	No	No	No	No	Yes. Excluded participants with severe hypoxic brain injury and who required further resuscitation in hospital
Inclusion and exclusion criteria clearly outlined?	Yes	Minimal	Yes but appeared to be based on the cases identified	Minimal	Yes	No	Yes
Comparison group? If so was it appropriate?	No	No	No	No	No	No	Yes, but not appropriate (healthy matched controls)
Sample size	12	32	43	63	26	22	50
Time of follow up similar for all participants?	No, ranged from 7 to 98 months	No, ranged from 2 to 7 years	Yes, from 5 to 14 months, majority between 5 and 10 months	Mean of 36 months (SD=18.8 months)	No, ranged from 17 to 40 months	Yes, 2 years	No, ranged from 5 to 68 months
Main outcomes and measured clearly described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Statistical analysis clearly reported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Results clearly outlined?	Yes but mainly descriptive	Yes	All descriptive statistics	Yes	No, significance of findings not explicit	No, only mean scores provided	Yes

Psychosocial outcomes

The psychosocial outcomes examined in the studies were thematically grouped into QOL, participation in society, ADL, symptoms of anxiety, depression and PTSD, living situation and employment status of participants. The main findings of individual studies are summarised in table 3.

Table 3: Summary of findings of the studies

Psychosocial factor	Measure used	Study	Findings
Living situation	Semi-structured interview	1	<ul style="list-style-type: none"> • Prior to cardiac arrest all 12 participants lived in their own home without assistance • At follow up nine participants (75%) were dependent on others with three participants living in a nursing or residential home
	Specifically designed questionnaire	2	<ul style="list-style-type: none"> • No information provided regarding living situation prior to cardiac arrest • At follow up ten participants (62.5%) lived at home without assistance, three participants lived at home with assistance (19%) and one lived in sheltered accommodation
	Not stated	3	<ul style="list-style-type: none"> • No information provided regarding living situation prior to cardiac arrest • At follow up all participants lived in their own home, 42 (98%) without support and one with support
	Not stated	4	<ul style="list-style-type: none"> • Living situation of participants was similar at follow up to before the cardiac arrest • Prior to cardiac arrest 54 participants (86%) lived in their own home without support, eight (13%) lived at home with support and one participant lived in supported accommodation • At follow up 53 participants (84%) lived in their own home without support, 8 (13%) lived at home with support, one participant lived in sheltered accommodation and one in a nursing home
	Specifically designed questionnaire	5	<ul style="list-style-type: none"> • Prior to cardiac arrest all 26 participants lived in their own homes without assistance • At follow up 20 participants (77%) lived in their own home without assistance, one participant lived in their own home with assistance and 5 participants (19%) lived in a nursing home
	Not stated	6	<ul style="list-style-type: none"> • No information provided regarding living situation prior to cardiac arrest • At follow up 14 participants (64%) lived in their own home without support, two participants (9%) lived in their own home with support and six (27%) lived in supported housing
Employment status	Semi-structured interview	1	<ul style="list-style-type: none"> • Ten participants (83%) were in employment prior to cardiac arrest, no information was given on the other participants • At follow up only one participant returned to employment and one participant was on sick leave. No information was given about the remaining participants

Psychosocial factor	Measure used	Study	Findings
Employment status (continued)	Specifically designed questionnaire	2	<ul style="list-style-type: none"> • No information provided regarding employment status prior to cardiac arrest • At follow up two participants (12%) were in full time employment, one participant (6%) was in part time employment, two participants (12%) were unemployed, one was retired and eight (50%) were retired due to ill health
	Not stated	4	<ul style="list-style-type: none"> • Prior to cardiac arrest 30 participants (48%) were working full time, five (8%) were in part-time employment, five (8%) were unable to work due to health reasons and 17 (27%) were retired • At follow up 17 participants (27%) were in full time employment, 10 (16%) were in part-time employment, six (10%) were unable to work due to health reasons, 22 (35%) were retired, one participant was unemployed and one involuntary work
	Specifically designed questionnaire	5	<ul style="list-style-type: none"> • Prior to cardiac arrest 17 participants (65%) were in employment, four (15%) were on sick leave or retired due to health reasons and five (19%) were retired • At follow up four participants (15%) were employed, 14 (54%) were on sick leave or retired due to health reasons and eight (31%) were retired
	Not stated	6	<ul style="list-style-type: none"> • Fourteen participants were below the age of retirement at follow up and four of these (29%) had returned to either full or part-time employment
	Nottingham Health Profile (NHP)	5	<ul style="list-style-type: none"> • All dimensions differed when compared to a reference population⁴⁰ and post MI patients⁴¹, however it was not stated if the difference was statistically significant. • Participants scored lower QOL than the reference population in the energy, physical mobility, emotion and social isolation dimensions and better QOL in the pain (p<0.01) and sleep dimensions, again statistical significance not stated • Participants scored lower QOL than the post myocardial infarction patients in emotion and social isolation dimensions and better in the energy, physical mobility, pain and sleep dimensions. It was not stated if the difference was significant
	Nottingham Health Profile (NHP)	7	<ul style="list-style-type: none"> • Participants had significantly lower QOL in emotional reaction (p<0.01), energy level (p<0.001), physical mobility (p<0.001) and sleep (p<0.05) than the comparison group

Psychosocial factor	Measure used	Study	Findings
Quality of Life (continued)			
	The Everyday-Life Questionnaire	7	<ul style="list-style-type: none"> Participants had significantly lower QOL compared to the comparison group in physical functions ($p<0.01$), daily life ($p<0.05$) and joy of life ($p<0.05$)
	Short Form Health Survey (SF 36)	4	<ul style="list-style-type: none"> Health related QOL is just below average 24% showed a lower QOL than the general population Male patients found to have a higher QOL ($\beta=-0.26$, $\beta=-0.24$, $p<0.05$) Older participants found to have lower QOL on the physical component ($\beta=-0.32$, $p=0.01$)
Participation in society	Impact on Participation and Autonomy Questionnaire (IPAQ)	2	<ul style="list-style-type: none"> Participants showed lower social functioning compared to a population visiting their GP.⁴² A significant association between family role ($r=0.60$, $p<0.05$), autonomy outdoors ($r=0.69$, $p<0.01$) and social relations ($r=0.57$, $p<0.05$) domains and coma duration. Therefore suggesting that longer coma duration is a good predictor of difficulties with participation in society A significant association between family role ($r=0.84$, $p<0.01$), autonomy outdoors ($r=0.80$, $p<0.01$) and social relations ($r=0.76$, $p<0.01$) domains and scores on the cognitive failures questionnaire. This suggests that cognitive difficulties can predict increased difficulties with participation in society
	The Community Integration Questionnaire (CIQ)	4	<ul style="list-style-type: none"> 45 participants (74%) scored as impaired Male patients found to have lower participation in society ($\beta=-0.24$, $p<0.05$) Older participants found to have lower participation in society ($\beta=-0.34$, $p=0.01$)
Activities of daily living	Frenchay Activities Index	2	<ul style="list-style-type: none"> A significant association between activities and post traumatic amnesia ($r=-0.70$) No association between activities and QOL or participation and autonomy
	Frenchay Activities Index	4	<ul style="list-style-type: none"> 12 participants (20%) scored as impaired Male participants were found to have lower ADL than female participants ($\beta=0.23$, $p=0.04$) Age was found to be a significant factor with older participants having lower levels of ADL ($\beta=-0.31$, $p=0.01$)

Psychosocial factor	Measure used	Study	Findings
Activities of daily living (continued)	Self-report rating of activities of daily living	1	<ul style="list-style-type: none"> A discrepancy between self and proxy reports, with a relevant mean difference on 13 of 30 items, with self reports of less of a problem suggesting that individuals either lack insight into or under report their difficulties with ADL
	The Barthel Index	4	<ul style="list-style-type: none"> 2 participants (3%) scored as impaired
	Personal activities of daily living (P-ADL) Instrumental activities of daily living (I-ADL)	5	<ul style="list-style-type: none"> P-ADL was a problem for 3 of the 20 participants I-ADL was a problem for 7 of the 20 participants A significant difference was identified between those scoring within the normal range on the Mini Mental State (MMS) and those scoring lower on the MMS for both P-ADL ($p<0.01$) and I-ADL ($p<0.05$). This suggests that individuals with impaired cognitive functioning are more likely to experience difficulties with ADL
	Functional Independence Measure (FIM)	6	<ul style="list-style-type: none"> All individuals who were unable to return to their homes or work were dependent motor functions All but one of the individuals who were unable to return to their homes or work were dependent social-cognitive functions
	Hospital Anxiety and Depression Scale (HADS)	4	<ul style="list-style-type: none"> Mean total score of 8.5, 22 participants (35%) scored as impaired Mean anxiety subscale score of 4.4, 8 participants (13%) scored as impaired Mean depression subscale score of 4.2, 9 participants (14%) scored as impaired
Symptoms of anxiety and depression			

Psychosocial factor	Measure used	Study	Findings
	Hospital Anxiety and Depression Scale (HADS)	3	<ul style="list-style-type: none"> • In total mood disorder was noted in 14% of participants • Two participants were identified as having moderate to severe depression with anxiety • Two to four participants were identified as having minor depression or anxiety
	Montgomery and Astrand Depression Rating Scale (MADRS-S)		
Symptoms of post traumatic stress	Impact of Event Scale	4	<ul style="list-style-type: none"> • 13 participants (21%) met the criteria for impaired levels of PTSD symptoms

Living situation

Information regarding the living arrangements was gathered in six studies. In three, the living situation of participants both before the cardiac arrest and at follow-up was reported and the remaining three articles reported living situation at follow-up but not prior to the cardiac arrest. Therefore, we were unable to determine whether the living situation had changed following the cardiac arrest.

In the studies reporting living situation before and after cardiac arrest, between 75% and 98% (mean 87.6%) of the individuals who were living in their own homes prior to the cardiac arrest returned to living in their own homes. Many of the participants, although living in their own home, required support from others following the cardiac arrest. Of the studies that obtained this information the number of participants requiring support ranged widely from 2% to 75%. All but one of the studies that reported information about living situation included participants who required support to the extent that they lived in supported housing or a nursing home. The number of participants living in supported housing or a nursing facility ranged from 0% to 27% (mean of 13%). The results regarding living situation in each study can be seen in table 3.

Employment status

Information about participants' employment status was gathered in six of the studies reviewed (see table 3) and in five of these this was compared to their employment status prior to cardiac arrest. The proportions of participants returning to work following the cardiac arrest ranged from 10% to 77% (mean 39.2%). However, many who had returned to work had decreased the number of hours, including working part-time rather than full-time as they had previously done.

Consideration should be given to the time between cardiac arrest and follow up, as this was up to approximately eight years for some participants,

therefore the change in employment may be due to other factors such as reaching the age of retirement or other age-related health issues.

Quality of life

The concept of QOL is multidimensional and vague, and as a result, there is no consensus on a single definition of QOL (QOL).⁴¹ Despite this, there has been a focus on the importance of understanding the impact on individuals' psychological, social and physical well being and therefore the measurement of QOL in individuals with health conditions has increased.⁴² The QOL of individuals is measured in healthcare as a way of taking into account their views and in measuring the effectiveness of the medical care they received. Health related QOL is commonly measured by using either a generic measure which measures different aspects of QOL or a measure specific to a health condition.

Four of the studies reviewed included a measure of QOL (see table 3), with three of them using generic measures of QOL and one using a questionnaire measuring QOL after brain injury (study 2). All studies found that individuals who had ABI following cardiac arrest had reduced QOL in at least some areas. Caution should be taken when considering these results however, as there was no information regarding the participants' QOL prior to cardiac arrest and therefore it is unknown whether QOL reduced after the ABI.

Studies 5 and 7 both used the Nottingham Health Profile (NHP) which, although has received criticism for assessing if an individual has a health problem rather than their QOL, is widely used as a measure of health-related QOL and is one of the most commonly used general measures in the UK.⁴³ Both of these studies found QOL significantly differed between the participants and a general population; with significantly lower QOL in the energy and physical mobility dimensions in both of these studies, and in emotion and social isolation dimensions in one of the studies (study 5). There was a discrepancy in the sleep dimension of the NHP between the two studies, with one (study 5) finding QOL in this dimension significantly

higher than the general population and the other (study 7) finding this to be significantly lower.

Sunnerhagen et al. (study 5) also compared the QOL of the participants in their study to previous research using the NHP with individuals with MI.⁴⁰ They found that individuals with ABI following cardiac arrest had a lower QOL in emotion and social isolation but better QOL in energy, physical mobility and sleep.

There appeared to be a gendered and age-related distinction in terms of QOL, with Study 4 reporting that male participants had significantly higher QOL than females and that older participants had a significantly lower QOL, however this was the only study to report these distinctions. An association was also found between QOL and the duration of coma and post traumatic amnesia (study 2). This was again only reported by one study however.

Participation in society

The social functioning or level of participation in society was investigated in two studies reviewed (see table 3), both using a different measure. The community integration questionnaire used in study 4 was devised for use with individuals with traumatic brain injury and has been found to be a valid measure and have a factor structure which is both clinically and theoretically appropriate.⁴⁴ The Impact on participation and autonomy questionnaire used in study 2 has been found to be a valid and reliable measure of participation in individuals with chronic health conditions.⁴⁵

Both studies found that individuals showed impaired participation in society with 74% of participants in Wachelder et al.'s study (study 4) scoring as impaired and participants in Middelkamp et al.'s study (study 2) having significantly lower participation when compared to individuals visiting a GP using the same measure in a previous study.⁴⁶

Wachelder et al. (2009) found a significant association between participation in society and both age and gender; with male and older participants having lower levels of participation. The lower social participation in older individuals may be due to them having fewer opportunities or physical difficulties. This is consistent with findings that older individuals in the general population participate less in society than younger individuals.⁴⁷ Middelkamp et al. (2007) found a significant association between participation in society and coma duration.

Activities of daily living

Participant's ADL were explored in five of the studies and the general findings can be seen in table 3. A range of measures were used in the studies with two studies using the Frenchay Activities Index which was initially devised for assessing the functional status of individuals who have suffered a stroke, and the other studies using measures including the Barthel Index, Functional Independence Measure and self-report measures of Personal and Instrumental Activities of Daily Living. The Barthel Index and Functional Independence Measure have both been identified as useful tools for measuring functional independence with generally good psychometric properties.^{48,49}

All of the studies identified difficulties in this area with reported findings of 3% (study 4) and 15% (study 5) of participants being dependent in personal daily activities, and 20% (study 4) and 35% (study 5) of participants being dependent on others in instrumental activities. A significant association was found between performance in activities of daily living and the duration of post traumatic amnesia (study 2) and between activities of daily living and age and gender, with males and older individuals showing more difficulties.

Anxiety and depression symptoms

Three studies assessed symptoms of anxiety and depression in participants (see table 8). Four different measures were used in total and two of the

studies (3 and 4) used the Hospital Anxiety and Depression Scale measure for anxiety and depression symptoms, which is frequently used in clinical practice. The tool was developed to assess anxiety and depression in clinical populations. The number of individuals meeting the criteria for a mood disorder varied in studies 3 and 4, with between 14% and 35% having symptoms of anxiety and depression.

Saner et al. (study 7) found no significant difference in anxiety and depression symptoms between participants and the healthy matched control group, which may have been due to the measure they used (Psychological General Well-Being Index) to assess the levels of anxiety and depression in their sample. This measure requires individuals to rate their feelings related to dimensions of anxiety, depression, positive well-being, vitality, self-control and general health on a six-point scale. The scale was devised as a measure of QOL and therefore may not be an appropriate measure of anxiety and depression symptoms.

None of the studies provided any information about participants' psychological distress prior to cardiac arrest and therefore it is not known whether the psychological difficulties were a result of the ABI or cardiac arrest. This is worth considering as research has identified that depression can be a risk factor for cardiac problems.⁵²

Post traumatic stress

Study number 4 was the only study to measure symptoms of stress reaction following a traumatic event. They used the Impact of event scale and found that 13 participants (21%) met the criteria for impaired levels of post traumatic stress symptoms. This finding was in line with previous findings where survivors of both in-hospital and out-of-hospital cardiac arrest were found to experience post traumatic symptoms.^{2,9} O'Reilly et al found a similar proportion on in-hospital cardiac arrest survivors to Wachelder et al with 19% of their sample meeting diagnostic criteria for the disorder.

Discussion

The psychosocial functioning of cardiac patients (e.g., who have angina, MI, heart failure or have had cardiac surgery) has recently become a focus for medical professionals and it is now seen by some as an important outcome measure of treatment effectiveness as well as just survival rates. This has resulted in an increase in measurement of psychosocial functioning, particularly QOL, in a variety of cardiac patients over the last 20 years.⁶¹ Such literature has identified psychosocial difficulties such as increased levels of anxiety and depression symptoms⁷ and reduced QOL.⁵³

This review, however, identified only a small number of studies exploring the psychosocial outcomes of ABI as a result of cardiac arrest, highlighting the limited amount of literature in this area. The studies included had limitations including the retrospective design used in the majority of them, generally small sample sizes, and the lack of appropriate control groups. The studies also investigated different outcomes limiting synthesis of information further; for example, ADL was explored in five of the studies reviewed, whereas only one study considered symptoms of post traumatic stress and only two considered participation in society. The follow-up periods also varied with outcomes being measured at six months to seven years across the studies. Some of the studies also did not report their findings in detail and therefore the information that could be extracted was limited. Due to these limitations it is difficult to generalise the findings of the studies reviewed, however this review provides information on the current findings and identifies areas that individuals with ABI following cardiac arrest have difficulties with. All of the studies included in the current review were conducted in Austria, Sweden, Switzerland and the Netherlands, therefore it is unclear as to whether there would be cultural differences in the psychosocial outcome and this is an area for further research.

The majority of individuals in each study reviewed were male (between 59% and 86%, mean 79%) which, although is representative of the gender differences identified in individuals who have suffered cardiac arrest and

brain injury, may have impacted on the results of the studies. Research into the QOL of cardiac patients has previously been criticised for using a predominantly male sample.⁵³ In their study comparing the QOL of male and female with a cardiac diagnosis Emery et al. found that females had a significantly lower QOL than males. Similar results have also been found in cardiac patients.^{54, 55}

The findings of the studies reviewed suggest that individuals who have ABI following cardiac arrest experience a range of psychological and social difficulties. The living situations of survivors was affected with up to 25% being unable to return to living in their own home due to the level of support they required. Many of the individuals who were able to return to living in their own homes required some level of support from others. The ability to return to employment was also affected with between only 10% and 77% being able to return to work, and many of those who returned to work worked reduced hours. Future literature could compare the psychosocial outcome of individuals who are able to return to their own homes and individuals who are not, as dependency may affect QOL or psychological functioning.

Only three of the studies reviewed explored anxiety and depression symptoms and the findings were variable. One study found no significant difference between participants and a control group, whereas the other two studies did find that individuals experienced anxiety and depression symptoms following the cardiac arrest. The latter findings are consistent with other studies which showed that individuals who experienced in-hospital cardiac arrest experienced anxiety and depression symptoms, with one study reporting 30% of participants having experienced clinical levels of anxiety and 15% experienced clinical levels of depression.² Other studies have reported between 15 and 25% of cardiac patients experiencing severe depression.⁹ Increased levels of anxiety and depression symptoms are also well documented in individuals following stroke⁵⁶ and traumatic brain injury.⁵⁷

Participants were generally found to have a reduced QOL in a number of areas and reduced participation in society. Difficulties with ADL was also common for individuals with anoxia following cardiac arrest with many being dependent on others for at least some daily activities. These findings have identified comparable psychosocial difficulties to the psychosocial difficulties found to be experienced by individuals who have suffered a traumatic brain injury^{57,58} and stroke.^{59,60}

It has previously been reported that individuals with cardiac problems and individuals with brain injury experience psychosocial difficulties, and the current review has identified evidence to suggest individuals who have suffered ABI and a cardiac arrest experience similar difficulties. It would therefore be useful for future research to compare the psychosocial outcome of individuals with anoxia following cardiac arrest and individuals who have experienced cardiac arrest but not anoxia, to investigate the impact of experiencing both on psychosocial functioning. No such research has been identified.

Further information about the psychosocial impact of anoxia following cardiac arrest could also be valuable for intervention and treatment guidelines as this is often not considered. The success of resuscitation following cardiac arrest is predominantly measured by examining survival rates alone, however it has been suggested that this is not sufficient and that the quality of an individual's life should also be considered.⁴²

The current UK Resuscitation Guidelines⁶² also focus on survival as a measure of success and a poor outcome is described as vegetative state or death. Therefore, it is important that more is known about the outcome for individuals who experience anoxia following cardiac arrest to ensure that the appropriate support can be offered. This is particularly important as survivors of cardiac arrest are a growing population due to advances in medical interventions. One such advance in medical interventions following cardiac arrest is the use of therapeutic hypothermia where the body

temperature is deliberately lowered to reduce damage to the brain during and after the anoxic event.⁶³

Following promising findings of improved neurological outcome following therapeutic hypothermia in 2002,^{64,65} hypothermia was recommended as an intervention following cardiac arrest by organisations such as the International Liaison Committee on Resuscitation and American Heart Association.⁶⁶ The National Institute of Clinical Excellence⁶⁷ is currently developing guidelines for the use of therapeutic hypothermia as a treatment following cardiac arrest to reduce the risk of brain injury. In the systematic literature reviews which formed the evidence base considered in the development of the guidelines, the outcomes measured again focused on survival, clinical outcomes and measures of neurological outcome including Glasgow Coma Scale scores and Cerebral Performance Category scores (a five category measure of consciousness). Information about the psychosocial outcome of anoxia would be useful, particularly if this is improved with the use of therapeutic hypothermia.

The efficacy of therapeutic hypothermia in reducing brain injury following cardiac arrest is promising. This will result in increasing the survival rate following cardiac arrest; however it is possible that more people may survive with the effects of anoxia. As this technique becomes a routine intervention further research investigating the long term psychosocial outcome for individuals would be valuable in order for them to receive appropriate support.

A limitation of the current review is that studies investigating the cognitive outcome of ABI following cardiac arrest may have included a measure of psychosocial functioning, however due to not being identified in the literature search or by being excluded based on the title, these would not have been included in the review. To overcome this limitation the full text of all studies would need to be screened which was beyond the scope of the current review. The review also only included articles written in the English language which may have resulted in relevant studies being excluded.

Conclusion

The psychosocial impact of ABI following cardiac arrest remains a relatively under-researched area and further research is required in this area. Individuals who experience anoxia following cardiac arrest have been found to have a range of psychosocial difficulties and more information about this would enable appropriate support to be made available for this growing population.

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Journal paper

The psychosocial outcome of anoxic brain injury following cardiac arrest²

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Abstract

Aim of the study

The aim of the current study was to investigate the psychosocial outcome for individuals with anoxic brain injury following cardiac arrest by comparing their outcome with cardiac arrest survivors without anoxic brain injury.

Methods

A range of self report measures were used to compare the quality of life, social functioning and symptoms of anxiety, depression and post traumatic stress of individuals with and without anoxic brain injury. Secondary measures of subjective memory and executive difficulties were also used. 56 participants (27 with anoxia, 29 without anoxia) took part in the study between six months and four years after experiencing cardiac arrest.

Results

A MANOVA identified a significant multivariate difference between the two groups, with individuals with anoxia reporting more psychosocial difficulties. They reported more social functioning difficulties and more anxiety, depression and post traumatic stress symptoms. There was no significant difference in self-reported quality of life between the two groups.

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Conclusion

As the first known study to compare outcome for cardiac arrest survivors experiencing anoxic brain injury with those without anoxia, the current results suggest that outcome is worse for cardiac arrest survivors who experience anoxia. This could be due to a combination of neuropsychological, social and psychological factors.

Introduction

For a more detailed discussion of the background literature, please refer to the extended background section.

Cardiac arrest (CA) continues to be the most common cause of death in Europe (Handley et al., 2005), however, as medical interventions advance, the number of people surviving CA is increasing (Hirsch, Koenig, & Geocadin, 2009). Prevalence rates vary, but there are estimates of 275,000 cases of CA per year in Europe (Atwood, Eisenberg, Herlitz & Rea, 2005). For some individuals treatment following CA can involve having an implantable cardioverter defibrillator (ICD) implanted which is gold standard intervention for ventricular arrhythmia which can result in cardiac arrest (Sola & Bostwick, 2005). An ICD detects disturbance in the heart's rhythm and provides defibrillation internally. The shocks it supplies can be painful and frightening.

A lack of oxygen to the brain for as little as a few minutes during CA can result in diffuse acquired brain injury ([ABI] Cohan et al., 1989). The structural damage to the brain caused by anoxia can vary and areas identified to be particularly susceptible include the cerebral cortex, hippocampus, cerebellum and basal ganglia, whereas structures such as the brainstem, hypothalamus and basal forebrain are more resistant to damage (Geocadin, Koenig, Jia, Stevens & Peberdy, (2008); Garcia-Molina et al., 2006). Measures of the effectiveness of medical interventions for CA have tended to focus on survival rates; however there is an increasing emphasis on the importance of exploring the functional and psychosocial outcome for CA survivors, whether or not they experience ABI as a result.

The term 'psychosocial' is used to describe a broad range of psychological and social functions. Psychosocial outcome has been widely investigated in health conditions, including neurological and cardiac disorders. The psychosocial outcome of ABI following CA however is an under-researched area, with much of the psychological research concentrating on the cognitive

outcome (Caine & Watson, 2000; Moulaert, Verbunt, Van Heughten & Wade, 2009).

The limited existing research investigating the psychosocial outcome for CA survivors has provided variable findings; however there are suggestions that individuals surviving CA have lower quality of life (QOL) when compared to the general population (Sunnerhagen, Johansson, Herlitz & Grimby, 1996; Lungren-Nilsson, Rosen, Hofgren & Sunnerhagen, 2005). Survivors of CA with ABI have also been found to experience psychological difficulties including anxiety (Wachelder, et al., 2009), depression (Cronberg, Lilja, Rundgre, Friberg & Widner, 2009) and post traumatic stress disorder (PTSD) symptoms (Ladwig et al., 1999). Difficulties with activities of daily living (Wachelder et al., 2009) and social functioning (Middelkamp et al., 2007; Wachelder et al., 2007) have also been identified.

A range of psychological models can be used to explain poor adjustment following CA and the psychological difficulties individuals can experience. Suffering a CA can result in lifestyle changes such physical health problems preventing individuals from returning to employment. This can result in financial difficulty, dependence on others and reduced social contact.

From a cognitive appraisal model, how individuals interpret the CA event, their health and their situation after the CA can result in psychosocial difficulties. CA survivors who appraise their illness as a threat, uncontrollable or as an indicator of their nearing death may develop anxiety. Individuals who make such appraisals may also focus on physiological changes in their body and perceive these as cardiac symptoms resulting in and maintaining anxiety. If CA survivors have perceptions of being unable to complete tasks due to their health they may avoid them or avoid activities they think may cause another CA and this avoidance maintains the anxiety.

The unpleasant ICD shocks individuals can receive have been found to be associated with increased anxiety (Sola & Bostwick, 2005). The shocks may be a reminder to individuals about their cardiac arrest and health status.

How an individual perceives the shocks can also result in anxiety, for example they may be interpreted as an indicator of worsening health (Pauli, Wiedemann, Dengler, Blaumann-Benninghoff & Köhlkamp, 1999). Behavioural explanations can also be used to explain the presence of anxiety, lack of social participation and reduced QOL in some survivors of CA. From a classical conditioning paradigm, the ICD shocks are an unconditioned stimuli which elicit a fear response and when paired with an activity or situation in which the shocks occur, this becomes a conditioned stimulus and evokes anxiety. The activities or places where shocks are emitted are avoided which reinforces the anxiety and reduces participation in activity.

Individuals who perceive their situation as one of loss, for example loss of health and ability to complete tasks, may be more susceptible to low mood (Folkman & Greer, 2000). They could also perceive their loss of ability to return to a similar level of functioning as they had prior to the CA as a failure and avoid activities or situations for fear of failing. The avoidance of situations and activities results in decreased social contact and is associated with low mood. Experiencing CA can be viewed as a traumatic event; if CA survivors appraise the CA as a traumatic experience which was a significant threat to their life, they can develop PTSD symptoms and these can be triggered by events such as ICD shocks.

Individuals who experience anoxia following CA may experience difficulties due to the explanations above, however they also have to adjust to living with ABI. Due to the areas of the brain susceptible to anoxic damage, common cognitive difficulties include memory and executive functioning (Caine & Watson, 2000). Individuals with such difficulties may be unable to return to work and possibly be more dependent on others in activities of daily living. Again, how an individual appraises their difficulties and situation following sustaining ABI will influence whether they experience psychological difficulties.

Neuropsychological models have also been proposed to explain psychological difficulties following brain injury and there are suggestions that structural damage to specific areas of the brain can directly result in emotional difficulties. There is evidence to suggest that depression is a consequence of injury to the left dorsolateral frontal areas and the basal ganglia (Onsworth & Oei, 1998). Damage to areas including the hippocampus, cingulate cortex and pre-frontal cortex have been identified as inducing anxiety (Gray & McNaughton, 1996). Others suggest that, although neuropsychological factors play a part in the emergence of emotional difficulties following brain injury, outcome is based on a range of interacting factors including psychological and environmental factors (Moore, Terryberry-Spohr & Hope., 2006).

Despite individuals with anoxia having to adjust to ABI as well as CA, no study has been identified that explores whether those with ABI experience more psychosocial difficulties. The studies exploring psychosocial outcome following CA have included survivors without distinguishing whether they experienced anoxia or not, or have only included individuals with or without ABI. Individuals with suspected ABI following CA are increasingly being treated with therapeutic hypothermia in an attempt to reduce cerebral damage. This intervention has been found to be effective in improving survival rates and outcome (Bernard et al., 2002). Being admitted to an Intensive Treatment Unit (ITU) for this intervention however, could also result in psychological distress for individuals.

The aim of the current study was to explore if there is a greater impact on psychosocial outcome for individuals experiencing ABI as a result of CA. Individuals who suffered probable ABI as a result of CA were compared with individuals who had CA not resulting in ABI on a range of psychosocial measures. The measures explored psychological and social difficulties identified to be a possible consequence following CA and ABI, including QOL, social functioning and symptoms of anxiety, depression and PTSD. Measures of subjective memory and executive difficulties were also included

to explore whether psychosocial difficulties are associated with cognitive difficulties which may result from ABI.

Method

For more detailed information about the method of the study and the measures used, please refer to the extended methodology.

Participants

Individuals who had experienced CA between six months and four years previously and had been treated with an ICD were included in the study. Participants in the anoxia group had been diagnosed as experiencing probable ABI based on clinical symptoms (e.g. GCS<8) and as a result were admitted ITU for a period of therapeutic hypothermia. Participants in the non-anoxia group had not been identified as experiencing ABI following CA due to their clinical presentation (e.g. GCS>8). A main indication of neurological damage as a result of anoxia is coma (Nolan et al., 2008). A GCS score of 8 or less indicates coma and is used as criteria to indicate severe brain injury (Jennette, 2004).

All participants were aged over 18 and, due to the measures used, had the ability to understand the English Language. Individuals who had pre-morbid psychological difficulties, requiring medication or ongoing therapy, or a medical diagnosis or history that would affect neuropsychological functioning were excluded from the study.

Measures

The aim of the study was to understand psychosocial difficulties from the individual's perspective and therefore self-report measures were the most appropriate method. The measures used were all standardised and validated.

Quality of Life

QOL was measured using the Quality of Life Scale ([QOLS] Burckhardt, Woods, Schultz & Ziebarth, 1989), a 16-item questionnaire in which individuals rate their satisfaction in relation to a range of items including daily and social activities and relationships.

The QOLS was adapted for use with individuals with health conditions and has been found to be useful with a range of chronic health conditions including cardiac conditions (Burckhardt & Anderson, 2003).

Social functioning

The Social Functioning Questionnaire ([SFQ] Tyrer, 1990) was selected as a measure of perceived social functioning. The SFQ is an eight-item questionnaire on which individuals rate their functioning in areas including work & home tasks, finances, relationships and social activities. The measure has been found to have good reliability and validity (Tyrer et al., 2005).

Depression and anxiety symptoms

Symptoms of depression and anxiety were measured using the Hospital Anxiety and Depression Scale (HADS), developed by Zigmond and Snaith (1983) to assess symptoms in clinical populations. The HADS is a 14-item questionnaire in which the frequency of anxiety and depression symptoms are rated on a four-point scale. The HADS has been found to have good reliability and validity when used to assess anxiety and depression in medical patients (Herrmann, 1997).

Post traumatic stress symptoms

PTSD symptoms were measured using the Impact of Event Scale-Revised ([IES-R] Weiss & Marmar, 1997), a 22-item questionnaire based on the

original Impact of Event Scale (Horowitz, Wilner & Alvarez, 1979) with the introduction of seven new items exploring hyper-arousal symptoms as well as avoidance and intrusion symptoms (Weiss, 2007).

This measure has previously been used with cardiac patients with findings of good reliability (Baumert, Simon, Gundel, Schmitt & Ladwig, 2004) internal consistency (Beck et al., 2008; Creamer, Bell & Failla, 2003), and concurrent and discriminant validity (Beck et al., 2008).

Subjective rating of memory difficulties

A subjective rating of everyday memory failures was gained using the Everyday Memory Questionnaire-Revised ([EMQ-R] Royle & Lincoln, 2008) a 13-item questionnaire adapted from the original Everyday Memory Questionnaire (Sunderland, Harris & Baddeley, 1983).

Subjective rating of executive difficulties

A subjective rating of executive difficulties was gained using the Dysexecutive Questionnaire (DEX) from the Behavioural Assessment of the Dysexecutive Syndrome (Wilson, Evans, Alderman, Burgess & Emslie, 1997). The questionnaire was completed by the participants and a family member. The 20 items consider emotional or personality changes, motivational changes, behavioural changes and cognitive changes.

Demographic and clinical information

Demographic information collected included the participants' age, gender, employment status and living arrangement and clinical information included whether the individual received bystander CPR, the number of shocks received, GCS score and down time.

Method

Ethical approval was granted by a local NHS Research Ethics Committee. Cardiac arrest survivors were identified from an existing database of ICD patients in two NHS Trusts in the UK. These individuals were sent an assessment pack by post containing a letter from the Consultant Cardiologist introducing the study, a participant information sheet, demographic information sheet, the self-report questionnaires and a stamped return envelope addressed to the researcher. Clinical information was obtained from the Cardiologist for participants who returned the questionnaires, including whether they had been identified as having and were treated for probable anoxia or not.

The measures were scored in accordance with the standardised instructions and any missing data was replaced with the participant's mean score for the scale or subscale. The scores obtained by participants in the two groups were compared using multiple analyses of variance (MANOVA).

Participant Characteristics

168 individuals met the initial criteria and were invited to take part in the study, 64 returned the completed questionnaires giving a 38% response rate. Eight participants were excluded from the study as they had either a history of mental health problems which commenced prior to the CA or had other neurological diagnoses such as encephalitis or had experienced a stroke. Therefore there was a total of 56 participants in the study, 27 (48%) of which met the criteria for probable anoxia and 29 (52%) for non-anoxia.

Participants' ages ranged from 37 to 84 years (mean= 66.13, SD= 12.61) and these were similar across the two groups. Details of participant characteristics can be seen in table 1. In regard to gender 37 (66%) of the participants were male and 19 (34%) female. There were a higher proportion of males in the non-anoxia group (83%) than in the anoxia group (48%). The participants in the two groups were well matched in regard to

time since CA, with the mean time being 27.78 months for the anoxia group and 25.81 months for the non-anoxia group. The living situation and employment status of participants will be discussed further in the results section.

Table 4 Participant Characteristics

	All participants (n= 56)	Anoxia (n=27)	Non-anoxia (n=29)
Age, mean (SD)	66.13 (12.61)	63.96 (12.59)	67.56 (12.64)
Gender			
Male	37 (66%)	13 (48%)	24 (83%)
Female	19 (35%)	14 (52%)	5 (17%)
Living arrangements			
Living alone	8 (14%)	2 (7%)	6 (21%)
Living with partner / family	46 (82%)	24 (89%)	22 (76%)
With carer	1 (2%)	1 (4%)	0
No information	1 (2%)	0	1 (3%)
Employment status			
Full-time employment	9 (16%)	4 (15%)	5 (17%)
Part-time employment	5 (9%)	3 (11%)	2 (7%)
Retired	39 (69%)	16 (59%)	23 (79%)
Unemployed	1 (2%)	0	1 (3%)
Sick leave	1 (2%)	1 (4%)	0
Voluntary work	1 (2%)	1 (4%)	0
Time since CA (months)	26.80 (12.87)	27.78 (12.99)	25.81 (12.91)
Mean (SD)			
Bystander CPR			
Yes	41 (73%)	20 (74%)	21 (72%)
No	10 (18%)	5 (19%)	5 (17%)
No information	5 (9%)	2 (7%)	3 (10%)
GCS score Mean (SD)		4.62 (4.16)	12.19 (4.90)

Results

For a justification of the statistical tests used, tests of assumptions and further results, please refer to the Extended Results section

A MANOVA was performed to assess the differences between the anoxia and non-anoxia groups across the range of psychosocial outcome measures. The scores on the IES-R were not included in the MANOVA as they violated the assumption of normality. There was a significant multivariate difference between the two groups (Pillai's Trace = 0.172, $f(4, 51) = 2.656$, $p = 0.043$; effect size (Partial eta squared [ηp^2]) = 0.172, observed power = 0.700). According to Cohen's conversion of effect sizes, this represents a large effect size ($\eta p^2 > 0.14$).

As the MANOVA was significant the univariate statistics were used to identify on which of the variables the groups differed. The mean scores on the measures for both groups and the results of the univariate tests can be viewed in table 2.

The anoxia group reported significantly more anxiety symptoms ($f(1) = 4.959$, $p = 0.030$, Cohen's $d = 0.59$), depression symptoms ($f(1) = 5.857$, $p = 0.019$, Cohen's $d = 0.64$) and significantly more difficulties with social functioning ($f(1) = 5.873$, $p = 0.019$, Cohen's $d = 0.64$). There was no significant difference between the two groups on the QOLS ($f(1) = 0.659$, $p = 0.420$, Cohen's $d = 0.2$). A Mann-Whitney test was used to explore the difference between the two groups on the IES-R and this identified a significant difference, with the anoxia group reporting more post traumatic stress symptoms than the non-anoxia group (total score, $u = 237.0$, $p = 0.011$; avoidance, $u = 236.5$, $p = 0.011$; intrusion, $u = 254.5$, $p = 0.024$; hyperarousal, $u = 237.5$, $p = 0.010$).

Table 5 Mean scores and standard deviations of measures

Measure	All participants	Anoxia	Non-anoxia	Difference (p)
QOLS	84.71 (14.87)	83.04 (17.04)	86.23 (12.63)	0.420
SFQ	4.45 (3.45)	5.56 (3.84)	3.41 (2.72)	0.019*
HADS				
Total	10.05 (7.07)	12.44 (8.12)	7.83 (5.13)	
Anxiety	6.05 (4.42)	7.37 (4.88)	4.83 (3.61)	0.030*
Depression	3.98 (3.28)	5.04 (3.78)	3.00 (2.43)	0.019*
IES-R				
Total	18.25 (19.50)	25.63 (23.11)	11.38 (12.21)	0.011*
Avoidance	0.88 (0.93)	1.20 (1.07)	0.57 (0.66)	0.011*
Intrusion	0.86 (0.95)	1.21 (1.14)	0.54 (0.60)	0.024*
Hyper-arousal	0.76 (0.97)	1.11 (1.19)	0.44 (0.59)	0.010*
EMQ-R				
Total	13.30 (13.08)	15.67 (13.85)	11.10 (12.14)	0.195
Retrieval	1.27 (1.14)	1.44 (1.19)	1.10 (1.08)	0.258
Attentional tracking	0.78 (0.96)	1.00 (1.09)	0.57 (0.79)	0.093
DEX				
Self	15.32 (10.97)	17.93 (12.10)	12.90 (9.37)	0.087
Independent	13.23 (11.43)	14.60 (14.02)	11.97 (8.40)	0.395

* Statistically significant

ANOVA test used for QOLS, SFQ & HADS; Mann-Whitney U test used for IES-R; T-test used for EMQ-R & DEX

Although it was identified that the anoxia group experienced more psychosocial difficulties than the non-anoxia group, the number of participants in each group exceeding clinical cut-off scores on each of the measures were also explored to assess the level of difficulties reported. The number and percentage of participants exceeding clinical cut-off scores can be seen in table 3. The most common difficulty experienced was anxiety; 52% of participants in the anoxia group scored above the cut-off score suggesting clinical levels and 11% of the anoxia group met the criteria for severe anxiety. A third of the anoxia group also reported experiencing mild or moderate levels of depression, compared to just 7% of the non-anoxia group. In regard to the IES-R, 22% of the anoxia group had scores representing clinical levels of PTSD symptoms compared to 7% of the non-anoxia group.

Table 6 Number and percentage of participants scoring within the clinical range

Measure (cut-off score)	All participants	Anoxia	Non-anoxia
HADS- Depression			
Mild (8-10)	9 (16%)	7 (26%)	2 (7%)
Moderate (11-15)	2 (4%)	2 (7%)	0 (0%)
Severe (>16)	0 (0%)	0 (0%)	0 (0%)
Total (>8)	11 (19%)	9 (33%)	2 (7%)
HADS- Anxiety			
Mild (8-10)	13 (23%)	9 (33%)	4 (14%)
Moderate (11-15)	4 (7%)	2 (7%)	2 (7%)
Severe (>16)	3 (5%)	3 (11%)	0 (0%)
Total (>8)	20 (36%)	14 (52%)	6 (21%)
IES-R			
Total (>33)	8 (14%)	6 (22%)	2 (7%)
Avoidance (>1.5)	11 (20%)	8 (30%)	3 (10%)
Intrusion (>1.5)	11 (20%)	9 (33%)	2 (7%)
Hyper-arousal (>1.5)	10 (18%)	7 (26%)	3 (10%)
EMQ-R			
Total (>2.07)	8 (14%)	4 (15%)	4 (14%)
Retrieval (>2.68)	9 (16%)	5 (19%)	4 (14%)
Attentional (>1.89)	5 (9%)	3 (11%)	2 (7%)

HADS (Hospital Anxiety and Depression Scale) cut-off scores suggested by Zigmund & Snaith (1994)

IES-R (Impact of event scale- revised) cut-off scores suggested by Creamer et al. (2003)

EMQ-R (Everyday Memory Questionnaire) cut-off scores suggested by Royle & Lincoln (2008)

The association between the scores on the psychosocial measures were also explored for the anoxia group. Consistent with evidence suggesting a high co-morbidity of anxiety and depression, there was a significant association between the scores on the anxiety and depression subscales of

the HADS ($r = 0.739$, $p < 0.001$). This was also the case for anxiety and PTSD symptoms ($r_s = 0.822$, $p < 0.001$) and depression and PTSD symptoms ($r_s = 0.710$, $p < 0.001$). Scores on the SFQ suggesting more difficulties were also significantly associated with increased anxiety symptoms ($r = 0.598$, $p = 0.001$), depression symptoms ($r = 0.773$, $p < 0.001$) and PTSD symptoms ($r = 0.624$, $p = 0.001$) which would be expected as reduced engagement in social activities is often associated with psychological distress.

It would be expected that, as the anoxia group reported significantly more psychosocial difficulties than the non-anoxia group, they would report significantly lower QOL, as psychological distress and poor social functioning is associated with reduced QOL. This was not the case in the current study however, as there was no significant difference in scores on the QOLS. Consistent with previous findings, however, poorer QOL was associated with more anxiety symptoms ($r = -0.690$, $p > 0.001$), depression symptoms ($r = -0.767$, $p > 0.001$), PTSD symptoms ($r_s = -0.623$, $p = 0.001$) and more social functioning difficulties ($r = -0.710$, $p > 0.001$) for the anoxia group. Poorer QOL was also associated with more anxiety symptoms ($r = -0.520$, $p = 0.004$), depression symptoms ($r = -0.527$, $p = 0.003$) and more social functioning difficulties ($r = -0.566$, $p = 0.001$) for the non-anoxia group but PTSD symptoms were not associated with QOL ($r_s = -0.350$, $p = 0.063$).

It was also expected that the anoxia group would report more cognitive difficulties than the non-anoxia group, however there was no significant difference between the two groups in regard to subjective memory difficulties (total score, $t(54) = 1.313$, $p = 0.195$; retrieval, $t(56) = 1.144$, $p = 0.258$; Attentional tracking, $t(54) = 1.710$, $p = 0.093$) or self rated executive difficulties ($t(54) = 1.746$, $p = 0.087$). Similar proportions of participants in each group also scored above the clinical cut-off scores outlined for the EMQ-R (see table 3). There was also no significant difference between the two groups on the independent rater score on the DEX ($t(56) = 0.857$, $p = 0.395$) and there was no significant difference between the self rater and

independent rater scores for either the anoxia group ($t(26) = 1.286$, $p = 0.210$) or the non-anoxia group ($t(28) = 0.595$, $p = 0.557$).

There were significant correlations between the scores on the psychosocial measures and the scores on both the EMQ-R and DEX (see Table 4). For the anoxia group more subjective memory difficulties were significantly associated with more social functioning difficulties, poorer QOL and anxiety, depression and PTSD symptoms. More self reported executive difficulties were significantly associated with more difficulties on all of the measures other than post traumatic stress symptoms. For the non-anoxia group more subjective memory and executive difficulties were associated with more social functioning difficulties, poorer QOL and more anxiety and PTSD symptoms but not depression symptoms.

Table 7 Associations between psychosocial outcome and subjective cognitive difficulties

	Anoxia group		Non-anoxia group	
	DEX (self)	EMQ-R	DEX (self)	EMQ-R
SFQ	0.156**	0.460*	0.882**	0.617**
Depression	0.560**	0.560**	0.350	0.336
Anxiety	0.627**	0.773**	0.569**	0.427*
QOLS	-0.487**	-0.401*	-0.533**	0.455*
IES	0.374	0.425*	0.656**	0.523**

* significant to 0.05 level

** significant to 0.01 level

Living situation can be an indication of the amount of social support an individual has, as it is presumed that individuals who live with their partner or family have more social support. The majority of the participants lived with their partner or family, with 89% of the anoxia group and 79% of the non-anoxia group reporting this. More participants in the non-anoxia group (21%) lived alone compared to those in the anoxia group (7%) and one person

from the anoxia group reported living with a carer. If living situation is an indication of social support, this information would suggest that the anoxia group have more than the non-anoxia group, however as no further information was available, it is not known whether this is an accurate indicator of social support and therefore this factor was not used to compare the psychosocial functioning of individuals.

The employment status of individuals can be used to indicate if individuals are able to return to their usual roles and activities. Return to employment has also been used in previous studies as an objective measure of an individual's QOL (Sears & Conti, 2002). In the current study a similar proportion of the participants in each group reported to be in full time employment (15% of the anoxia group and 17% of the non-anoxia group). Most of the participants were retired (59% of the anoxia group and 79% of the non-anoxia group), which may be due to the age of participants, as many of them had reached the age of retirement.

For the anoxia group, only scores on the anxiety subscale of the HADS were significantly associated with age with younger participants reporting more difficulties (see table 5). For the non-anoxia group age was significantly associated with scores on the SFQ and IES-R, again with younger participants reporting more difficulties. There were no statistically significant gender differences for any of the measures and none of the scores were associated with the length of time since CA or GSC score. Results for all of the above can be seen in table 5.

Table 8 Statistical results for gender differences and association with age, time since CA & GCS score

Measure	Gender differences		Association with age		Association with time since CA		Association with GCS score	
	Anoxia	Non-anoxia	Anoxia	Non-anoxia	Anoxia	Non-anoxia	Anoxia	Non-anoxia
QOLS	$t=0.728$	$t=-0.523$	$r=0.200$	$r=0.065$	$r=-0.086$	$r=0.016$	$r=0.092$	$r=-0.146$
SFQ	$t=-0.022$	$t=0.914$	$r=-0.106$	$r=-0.452^*$	$r=-0.005$	$r=-0.145$	$r=0.020$	$r=0.337$
EMQ-R	$t=0.145$	$t=0.621$	$r=-0.252$	$r=0.109$	$r=-0.277$	$r=0.029$	$r=0.009$	$r=0.150$
HADS (D)	$t=0.763$	$t=0.198$	$r=-0.041$	$r=0.079$	$r=0.092$	$r=-0.002$	$r=0.058$	$r=0.072$
HADS (A)	$t=0.768$	$t=0.421$	$r=-0.437^*$	$r=-0.172$	$r=-0.009$	$r=-0.004$	$r=-0.016$	$r=0.242$
DEX (S)	$t=1.026$	$t=0.648$	$r=-0.060$	$r=-0.322$	$r=-0.090$	$r=-0.100$	$r=0.086$	$r=0.098$
DEX (I)	$t=1.623$	$t=1.230$	$r=-0.045$	$r=-0.016$	$r=-0.333$	$r=-0.099$	$r=0.034$	$r=0.035$
IES-R	$u=69.00$	$u=56.00$	$rs=-0.350$	$rs=-0.391^*$	$rs=-0.128$	$rs=-0.152$	$rs=0.121$	$rs=0.092$

* Statistically significant

SFQ, social Functioning Questionnaire; IES-R, Impact of Event Scale- Revised; QOLS, Quality of Life Scale; HADS (D), Hospital Anxiety and Depression Scale depression subscale; HADS (A), Hospital Anxiety and Depression Scale anxiety subscale; EMQ-R (T), Everyday Memory Questionnaire- revised (total score), DEX (s), Dysexecutive Questionnaire (self rater), DEX (I), independent rater

Discussion

For further discussion of the current findings, please refer to the extended discussion

The current study identified individuals who experience ABI as a result of CA experience significantly more psychosocial difficulties than individuals who experience CA without ABI. Individuals who experienced ABI reported significantly more social functioning difficulties and anxiety, depression and PTSD symptoms. As well as adjusting to life following CA, and the social and health implications of this, the anoxia group also have to adjust to living with ABI.

As well as adjusting to living with ABI, individuals in the anoxia group were also treated on ITU in an attempt to reduce cerebral damage whereas the non-anoxia group were admitted to a cardiac ward following accident and emergency.. Admission to intensive care has also been associated with psychological difficulties, particularly in individuals who experience cognitive difficulties afterwards (Jackson et al., 2003). Therefore this experience may also have contributed to the difference between the two groups in the current study; however, as therapeutic hypothermia is increasingly used to treat individuals with ABI following CA, this is a typical experience for these individuals. Future research could investigate if the experience of ITU contributes to individuals' distress. For example qualitative methods could explore what individuals appraise in regard to the CA and whether this is the event, subsequent treatment or the resulting difficulties.

It is acknowledged that distinguishing whether individuals experience ABI or not can be difficult, even with neuro-imaging evidence. In medical practice the main method of identifying individuals with probable anoxia, and in decision making for appropriate interventions, is clinical evaluation of presentation, such as level of consciousness (Rabinstein & Resnick, 2009). In the current study, allocation to the anoxia or non-anoxia group was based upon these clinical decisions at the time of CA. Participants in the anoxia

group were individuals who had been diagnosed as having probable anoxia and as a result were treated with therapeutic hypothermia in an attempt to minimise neurological damage.

The current exploratory study aimed to investigate if there is a difference in psychosocial outcome between CA survivors who experience ABI and those that do not. A range of factors may be involved in the poor outcome for the anoxia group including neuropsychological, psychological and social factors and these will be considered based on the findings.

Living with ABI can result in reduced activities and social contact due to cognitive difficulties and increased dependence (Wachelder et al., 2009). The findings regarding social functioning were consistent with this, as individuals with anoxia reported significantly more social functioning difficulties compared to the non-anoxia group and these were significantly associated with subjective memory and executive difficulties. These findings are consistent with previous studies which have also identified a correlation between social functioning and cognitive difficulties (Middelkamp et al., 2007). Poor social functioning in individuals with ABI could be a result of them having negative appraisals of their ability to cope in situations due to their cognitive difficulties. This may result in avoidance or reliance on others in such situations. This, as well as reduced activities from other factors such as the inability to return to work, can result in having fewer social contacts.

Difficulties with social functioning were also found to be highly associated with anxiety and depression symptoms which could be expected as evidence suggests that engaging in fewer activities has a negative impact on mood, and that low mood and anxiety can cause low motivation and high avoidance which reduce engagement in activities. Findings in the current study were contradictory to those of Wachelder et al. (2009) who found that older participants had lower participation in society; this was the case in the non-anoxia group but not the anoxia group.

Employment status and living situation are often used as measures of levels of social support and return to usual roles and activities. A limitation of the current study is that there was no information about the employment status and living situation of participants prior to CA. As a result these could not be used as an indication of change, such as reducing hours of employment, retirement or whether they moved in with family members after the CA for support.

Anxiety was the most common problem experienced by individuals in the anoxia group, with 52% having a score indicating at least mild clinical symptoms. In the non-anoxia group 21% of participants experienced clinical levels of anxiety based on the HADS score. Snaith and Zigmond (1994) reported the percentage of a general population who met the scores for mild, moderate and severe anxiety on the HADS. They reported that 20.6% scored within the mild range, in the current study more participants in the anoxia group than would be expected scored within this range (33%) and in the non-anoxia group 14% scored within this range. Seven percent of both groups scored within the moderate anxiety range, compared to 10% of the general population. The percentage of the general population scoring within the severe anxiety range was 2.6%, none of the non-anoxia group met this level of symptoms, however 11% of the anoxia group did, which is more than would be expected based on the general population.

This finding is inconsistent with previous research where high levels of anxiety have been identified amongst CA survivors in studies where individuals who experience significant anoxia were excluded (Saner et al., 2002) and individuals living with ICDs (Sears et al., 1999) as only participants with ABI reported significant difficulties with anxiety symptoms. To account for the anoxia group having significantly more anxiety difficulties than the non-anoxia group, the impact that the anoxic brain injury has needs to be considered. How individuals appraise their difficulties following ABI could explain the difficulties with anxiety, for example if they experience cognitive difficulties which impact on their ability to undertake activities they may perceive their ability to cope as poor and activities as a threat.

Individuals who regularly perceive threat and inability to cope can experience anxiety. This may result in the avoidance of activities which will maintain the anxiety.

Neuropsychological models could also explain the differences in psychosocial difficulties between the two groups. These would suggest the emotional consequence is a result of the specific neurological damage sustained from the anoxia. Areas of the brain identified to be associated with anxiety include the hippocampus and cingulate and pre-frontal cortex (Gray & McNaughton, 1996). These are areas of the brain which have also been identified to be particularly susceptible to anoxic damage. Similarly, depression has been found to be associated with damage to the left dorsolateral frontal areas and the basal ganglia (Ownsworth & Oei, 1998), which again are susceptible to anoxic damage. Although it is not known if these areas were specifically affected in the participants of this study, this could be a factor which explains the increased anxiety and depression symptoms in the anoxia group.

Mild and moderate depression symptoms were identified in 33% of the participants with anoxia compared to 7% in the non-anoxia group. Considering the percentage of a general population meeting mild, moderate and severe depression on the HADS (Snaith & Zigmond, 1994), more of the anoxia group (26%) met the score for mild depression compared to the general population (7.8%) and a similar proportion of the non-anoxia group (7%) did. Seven percent of the anoxia group and none of the non-anoxia group scored within the moderate depression range compared to 2.9% of the general population.

As well as the neuropsychological explanations discussed, the social implications of CA and ABI, such as reduced activities and social functioning and how they their situation is appraised may impact on individuals' mood. Individuals who perceive their situation as one of loss, for example loss of health, cognitive function and ability to complete tasks, may be more susceptible to low mood. They could also perceive their loss of ability to

return to how they were prior to the CA as a failure and avoid activities or situations for fear of failing which will impact on their mood. Individuals with ABI may be more likely to experience loss of independence and ability due to cognitive difficulties resulting from the anoxia. As would be expected based on previous findings and psychological literature regarding co-morbidity of psychological disorders, there was a highly significant correlation between symptoms of anxiety and depression.

Clinically significant PTSD symptoms were present in 22% of the anoxia group compared to 7% of the non-anoxia group. As discussed the experience of treatment on ITU for individuals in the anoxia group could have contributed to the development of PTSD symptoms. Evidence suggests that a high proportion of individuals who are admitted to intensive care units (ICU) experience PTSD or related symptoms, with reports of between 14% and 27% meeting this criteria (Rattray & Hull, 2007). It is common that individuals have limited factual memories of being on ICU and therefore have odd perceptual experiences of that time which can be distressing (Rattray, Johnstone & Wildsmith, 2004). Individuals who appraise their time in ITU as a traumatic and unpleasant experience which was a significant threat to their life, as opposed to those who appraise it as a medical intervention that saved their life or have less unpleasant perceptions of that time, may be more likely to experience subsequent PTSD symptoms. Symptoms of PTSD can be triggered by events which are similar, or even in some cases unrelated to the perceived traumatic event (Schnurr & Friedman, 1997), for the participants in the anoxia group this could be receiving ICD shocks, perceived changes in physiological symptoms or cognitive difficulties which remind them of the event.

Despite the anoxia group having significantly more psychosocial difficulties than the non-anoxia group, there was no difference in scores on the QOLS between the two groups, suggesting QOL of life of CA survivors is similar whether the CA results in anoxia or not. However, consistent with previous findings (e.g. Moulaert et al., 2010), poorer QOL was found to be associated

with more social functioning difficulties, more anxiety, depression and PTSD symptoms and more subjective memory and executive difficulties.

Previous studies have found that survivors of CA have significantly lower QOL compared to non-clinical populations (Sunnerhagen et al., 1996; Saner et al., 2002; Lundgren-Nilsson et al., 2005). The mean score for both the anoxia (83.04) and non-anoxia (86.23) groups was below the non-clinical population average of 90 (Burckhardt & Anderson, 2003) with 70% of the anoxia group and 62% of the non-anoxia group scoring below the general population mean. Burckhardt & Anderson (2003) also reported mean scores for individuals with a range of health conditions, which ranged from 82 to 87 and the mean scores identified in this study are relatively comparable with this.

Contrary to previous findings suggesting QOL is associated with age and gender (Wachelder et al., 2009), this was not the case in the current study. This may be due to the different measures of QOL used; in the study finding an association with age and QOL, the short form health survey ([SF-36] Ware & Sherbourne, 1992) was used. The SF-36 is a questionnaire concerned with satisfaction with health status whereas the QOLS is a measure of subjective QOL taking into account all aspect of an individual's life. Specific measures of health related QOL, such as the SF-36, have been criticised for being more a measure of health rather than QOL. Older individuals may report more health problems but not differ from younger individuals in their evaluation of their general QOL.

Poorer psychosocial functioning was found to be associated with subjective cognitive difficulties and this may contribute to individuals with anoxia experiencing more difficulties. This is also consistent with other studies in which psychosocial functioning has been found to be associated with cognitive impairments (Sunnerhagen et al., 1996; Middelkamp et al., 2007). Despite this however, there was no significant difference between the two groups with regard to self-reported memory and executive difficulties. A possible explanation for this is individuals in the anoxia group may have

lacked insight into their cognitive difficulties which can be common following ABI (Ownsworth & Oei, 1998). This has been found to be associated with poor psychosocial functioning as individuals with poor insight have high expectations on their ability and recovery; when they fail to complete activities as they had prior to the injury, they perceive failure and experience distress. Other possible explanations for the lack of difference in self-reported cognitive difficulties could be individuals in the anoxia group under-reporting difficulties or, due to the age of participants, individuals in the non-anoxia group reporting symptoms of age-related cognitive decline.

The current study identifies that cardiac arrest survivors who experience anoxia are significantly more likely to experience psychosocial difficulties. This finding has clinical implications as psychosocial outcome can be used to measure the effectiveness of medical interventions for CA and can impact on the individual's future health (Barth, Shumacher & Herrmann-Lingen, 2004; Penninx et al, 2001). The findings suggest that cardiac arrest survivors, particularly those who experience anoxia as a result, should receive support to facilitate adaptive adjustment. Health professionals regularly involved in patients' care, such as cardiologists and general practitioners (GP), should be aware of the increased risk of psychological and social difficulties for this population and of the symptoms. Cardiac arrest survivors should also be provided with information about this risk and warned of symptoms to discuss with their GP. Psycho-education about the impact of avoidance of activity and the value of social support and appropriate coping strategies could be beneficial. Cardiologists and GPs could support this by providing thorough recommendations to patients about what types and levels of activity they can still engage in with their cardiac condition and engaging in activity should be promoted. Individuals who develop psychological difficulties such as PTSD, anxiety or depression should be referred to psychological services as appropriate. Interventions such as CBT that address negative cognitive appraisals and maintaining behaviour may be effective. Individuals with anoxia should also receive support for the cognitive difficulties they experience. This should include

cognitive assessment to identify specific deficits and recommendation of appropriate strategies or cognitive rehabilitation.

The current exploratory study aimed to identify if there was a difference between individuals who experience ABI as a result of CA and those that do not. Although possible explanations for the differences identified have been considered, it was beyond the remit of the study to investigate these as they did not directly relate to the aims. It is proposed that a number of interacting neuropsychological, social and psychological factors result in the psychosocial difficulties experienced. Future research could further explore the factors involved and this would be useful in identifying specific interventions to improve the psychosocial outcome. For example, neuro-imaging studies could investigate the areas of the brain affected in CA survivors with anoxia and whether there is an association between damage and social functioning, which may be due to lack of motivation, fatigue or symptoms of anxiety, depression, PTSD.

Although the interest of the current study was of individuals' subjective cognitive difficulties further research could combine subjective and objective measures of cognitive functioning to explore the association between cognitive difficulties and psychosocial difficulties and further examine whether factors such as lack of insight may be involved in the emergence of difficulties. Individuals' level of dependence, for example with the use of measures of activities of daily living, coping strategies, level of activities engaged in before and after CA and the level of social support individuals have could all be used to further examine the factors involved in the psychosocial difficulties resulting from ABI following CA.

Future research could investigate the cognitive appraisals of CA survivors to see if there is a difference in appraisals between CA survivors who experience ABI and those that do not. Qualitative methodology could be used to explore individual's cognitive appraisals of their health, situation and ability to adjust. There are a number of measures available which were devised to measure appraisals which could be used in further research.

These include the Cognitive Appraisal of Health Scale (Kessler, 1998) and the Stress Appraisal Measure (Peacock & Wong, 1990).

Self-report measures were used in the current study as the aim was to understand psychosocial difficulties from the individual's perspective. Future research could consider also collecting information from significant others to address any bias in reporting which is inherent in self-report measures. This could then be used to triangulate findings from individual perspectives.

Conclusion

The current findings add to the limited literature exploring the psychosocial outcome of anoxia following CA. As the first known study to compare outcome for CA survivors experiencing ABI with those without ABI, the results of this study suggest psychosocial outcome is worse for CA survivors who experience anoxia. Individuals with anoxia experience significantly more social functioning difficulties and symptoms of anxiety, depression and PTSD. Although better QOL was associated with fewer psychosocial difficulties, there was no significant difference in subjective QOL between the two groups. It is suggested that the difference is due to a combination of neuropsychological, social and psychological factors resulting from ABI following CA, however further research is required to explore this in more depth.

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Extended Paper

Extended background

Cardiac arrest

Cardiac arrests continue to be the most common cause of death in Europe (Handley et al., 2005). Prevalence rates vary, but there are estimates of 275,000 cases per year in Europe (Atwood, Eisenberg, Herlitz & Rea, 2005). A cardiac arrest occurs when the heart's rhythmic contractions are disrupted and cause it to stop beating. Individuals who have an out-of-hospital cardiac arrest have a poor prognosis (Steinmetz, Barnung, Nielsen, Risom & Rasmussen, 2008). Survival rates of less than 10% are frequently reported in the literature (e.g. Cummins, Ornato, Thies & Pepe, 1991; Atwood et al., 2005), although there are some variations in this and in a review of the literature rates of survival were found to vary between 1.6% and 20.7% (Becker, Smith & Rhodes, 1993). Survival rates for in-hospital cardiac arrest are slightly higher with reports of 14% to 18% (Peberdy et al., 2003; Bedell, Delbanco, Cook & Epstein, 1983; Rosenbaum & Shenkman, 1988). As medical interventions advance, the number of people surviving cardiac arrest is increasing (Hirsch, Koenig & Geocadin, 2009). Steinmetz et al. (2008) reported that survival rates increased from 8.3% to 16% following the implementation of new guidelines from the Resuscitation Council.

Survival following cardiac arrest is dependent upon appropriate and early intervention which includes a number of steps, often termed the 'chain of survival' in the literature (Cummins et al., 1991; Waalewijn, de Vos, Tijssen & Koster, 2001). Bystander cardiopulmonary resuscitation (CPR) administered immediately can increase the chance of survival by two to three times (Handley et al., 2005) as it produces and maintains blood flow until emergency services arrive (Cummins et al., 1991). A delay of more than three minutes in receiving CPR has also been associated with a decrease in survival of around 50% (Waalewijn et al., 2001). The heart's rhythm can be resumed by defibrillation where an electric shock is administered to the heart. The chance of survival has been found to reduce by 10 to 15% for every minute that defibrillation is delayed (Handley et al., 2005).

Some victims of cardiac arrest are treated by having an Implantable Cardioverter Defibrillator (ICD) implanted which detects disturbance in the heart's rhythm and provides defibrillation internally. Evidence suggests the use of ICD reduces mortality rate by over 20% (Kuck, Cappato, Siebels & Rüppel, 2000; Connolly et al., 2000). Survivors of cardiac arrest are at high risk of sudden cardiac death in the future and due to the effectiveness of ICDs in reducing this risk and the overall mortality rate, the use of ICDs is recommended by the National Institute for Health and Clinical Excellence (NICE, 2006).

Anoxic brain injury following cardiac arrest

When the heart stops beating during cardiac arrest the supply of oxygen to the brain is prevented. A lack of oxygen to the brain for as little as a few minutes can result in diffuse brain injury (Cohan et al., 1989). The terms 'anoxic', 'hypoxic' and 'ischemic' are frequently used interchangeably and synonymously to describe the cerebral injury caused by oxygen deprivation. The actual definitions of the terms hypoxia and anoxia describe the extent of the oxygen deprivation; hypoxia occurs with partial deprivation of oxygen and anoxia with total deprivation of oxygen and ischemia describes the lack of cerebral blood flow which results in anoxia or hypoxia (Roux, 2008). For the purpose of the current study and thesis the term 'anoxia' will be used.

The brain requires a constant supply of oxygen but does not have the capacity to store it. When the oxygen supply is disrupted a process is commenced to maintain cerebral blood flow and oxygen supply, however if the deprivation is sustained, this process becomes ineffective (Caine & Watson, 2000). Garcia-Molina et al. (2006) reported that individuals can lose consciousness after just twenty seconds of the loss of cerebral blood flow. There are reports that brain injury can begin to occur after just four minutes of oxygen deprivation (Cohan et al., 1989) and this results in coma.

In clinical practice the main method of identifying individuals with ABI and predicting outcome is clinical examination and this is the basis for decisions of intervention (Nolan et al., 2008). Clinical examination to identify ABI includes level of consciousness, presence of seizure activity, brainstem reflexes and vestibular reflexes (Meyer & Hall, 2006; Nolan et al., 2008). Other methods used to aid diagnosis include serum markers and biochemical indicators such as electroencephalography and somatosensory evoked potentials (Meyer & Hall, 2006).

The GCS is a commonly used scale initially devised to rate the level of consciousness, with coma usually being defined as a GCS of 8 or less (Jennette, 2004). The GCS is frequently used as an indicator of severity of brain injury in TBI and ABI with GCS of 8 or less indicating severe brain injury (Balestreri et al., 2004). Evidence suggests that GCS score is one of the most reliable predictors of survival and outcome, with lower scores being associated with poor survival rates and greater disability (Schefold, Storm, Kruger, Ploner & Hasper, 2009).

The effect of oxygen deprivation on different structures in the brain varies and this selective vulnerability is due to a range of characteristics including the arrangement of cerebral blood vessels and the metabolic properties of the neurons forming the structures (Caine & Watson, 2000). The areas of the brain vulnerable to anoxic damage include the cerebral cortex, hippocampus, cerebellum and basal ganglia, whereas structures such as the brainstem, hypothalamus and basal forebrain are more resistant to damage (Geocadin, Koenig, Jia, Stevens & Peberdy, (2008); Garcia-Molina et al., 2006).

Therapeutic hypothermia, an intervention in which an individual's core body temperature is cooled to 32–34°C for 12–24 hours before being slowly re-warmed, has been found to be effective in reducing brain injury following cardiac arrest. Although exactly how cerebral injury is minimised through therapeutic hypothermia is unknown, promising findings of improved neurological outcome following use of the intervention in 2002 (Bernard et

al., 2002; Hypothermia After Cardiac Arrest Study Group, 2002) resulted in hypothermia being recommended as an intervention following cardiac arrest by organisations such as the International Liaison Committee on Resuscitation and American Heart Association (Nolan et al., 2003). The National Institute of Clinical Excellence (NICE, 2011) has also recently introduced guidelines for the use of therapeutic hypothermia as a treatment following cardiac arrest to reduce the risk of brain injury. The efficacy of therapeutic hypothermia in reducing brain injury following cardiac arrest is promising with findings of improved survival rates and outcome (Nikolov & Cunningham, 2004; Bernard et al., 2002; Holzer et al., 2005).

In the systematic literature reviews which formed the evidence base considered in the development of the guidelines (NICE, 2010), the outcomes measured focused on survival, clinical outcomes and measures of neurological outcome including Glasgow Coma Scale scores and Cerebral Performance Category scores (a five category measure of consciousness). Researchers are identifying that longer term and functional outcome following therapeutic hypothermia is a neglected area which would be useful in evaluating the effectiveness of the intervention.

As the number of people surviving cardiac arrests increases due to the advances in medical intervention so does the population of individuals suffering from anoxic brain injury. Due to this there has been a shift in the focus of research looking at individuals who suffer cardiac arrest from mortality to morbidity (O'Reilly, Grubb & O'Carroll, 2004). Anoxic brain injury, due to cardiac arrest or other cause, has been less researched than other types of brain injury such as traumatic brain injury (TBI) and therefore less is known about the outcome of such injury. The psychological research that has been investigated the outcome of anoxic brain injury has concentrated on the cognitive outcome.

Cognitive outcome of anoxia

Memory disturbance has been the most researched and most frequently reported cognitive outcome of anoxia (e.g. Alexander, Lafleche, Schnyer, Lim & Verfaellie, 2011; Grubb, O'Carroll, Cobbe, Sirel & Fox, 1996). However, further research emerged which shows that individuals experience a range of cognitive difficulties following anoxia. Caine and Watson (2000) reviewed the literature on the neuropsychological outcome of anoxic brain injury and although they found memory to be affected, it was not the only cognitive difficulty to be identified as an outcome of anoxia. In only 13 of 67 individual cases (19.4%) and four (28.6%) of the research studies that they reviewed memory disturbance was the only cognitive difficulty identified.

The severity of cognitive impairment and type of impairment has been found to be due to the degree of brain damage suffered during the cardiac arrest (Khot & Tirshwell, 2006). Hopkins, Tate and Bigler (2005) compared individuals who had suffered an anoxic brain injury with individuals who had experienced a TBI and found that both groups displayed similar cognitive difficulties and concluded that these were due to the amount of tissue damage rather than the cause of the damage. Although a number of studies have considered the cognitive outcome of anoxia, less research has been conducted to investigate the functional or psychosocial outcome.

Memory

In their review of the literature, Caine and Watson (2000) reported that dysfunction in memory was present in 36 of the 67 individual case studies (54%) and memory disturbance was identified in all of the 14 papers they reviewed. Alexander et al. (2011) found that cardiac arrest survivors had significantly more memory impairments than a cardiac control group. Grubb et al. (1996) compared episodic long-term memory and short-term working memory performance in out-of-hospital cardiac arrest survivors and myocardial infarction sufferers (where the blood vessels to the heart become blocked causing damage to the heart but does not cause the heart to stop).

They found no significant difference in short-term recall but a significant difference between the two groups in episodic long-term memory, with 37% of the cardiac arrest survivors having moderate to severe impairments.

The disturbance in memory function has been found to be due to damage to the hippocampus, which is particularly susceptible to damage during anoxia (Hopkins, Tate & Bigler, 2005). The hippocampus has been identified as crucial in many types of memory including declarative, episodic and spatial memory (Burgess, Maguire & O'Keefe, 2002).

Executive functioning

Deficits in executive functions have also been identified in individuals who have experienced anoxia following cardiac arrest (Caine & Watson, 2000). A limitation of Caine and Watson's (2000) review of the literature however, was that in the majority of the studies they reviewed executive function was not formally assessed and in the studies that had used formal assessments, these were limited to only one or two tests. They found that behavioural and personality changes were more likely to be reported in the studies reviewed. This was identified based on observation and therefore the discrepancies in the methods of assessing executive functioning makes it difficult to compare the results. They identified changes in executive function, personality or behaviour in 31 (46.2%) of the 67 individual cases and eight (57%) of the 14 research studies.

Tiainen et al. (2007) assessed executive functions in individuals three months following cardiac arrest and reported that 33% of individuals had executive difficulties. Lim, Alexander, LaFleche, Schnyer and Verfaellie (2004) reported higher rates of executive function impairment, with 63% of individuals experiencing moderate to severe difficulties.

Language

Language had been considered to be an ability that remains intact following anoxia (Roine, Kajaste & Kaste, 1993), however although language is less affected than other cognitive abilities, more recent studies have found impairments. Garcia-Molina et al. (2006) assessed the language abilities of 32 individuals who had experienced anoxia and found they did have language impairments particularly on verbal comprehension and semantic verbal fluency tests. They concluded however, that none of the participants met aphasia diagnostic criteria and language difficulties were less impaired than other cognitive abilities. Caine and Watson (2000) reported that in the studies they reviewed that investigated language ability, expressive rather than receptive language function was most frequently found to be affected.

Visuospatial

Visuospatial difficulties have also been identified in individuals with anoxic brain injury following cardiac arrest (Wilson, 1996). In their review of the literature Caine and Watson (2000) noted that in 21 (31.3%) of the 67 individual cases visuospatial or visual recognition problems were identified, although visual recognition problems were less frequent.

Psychosocial outcomes

The term 'psychosocial' is used to describe a broad range of psychological and social functions. Measures of social functioning often include assessment of participation in society, activities of daily living (ADL) and quality of life (QOL). Psychological functioning is generally assessed by measuring symptoms of psychological distress such as symptoms of anxiety, depression (e.g. McGee, Hevey & Horgan, 1999) and post traumatic stress.

Good psychosocial functioning is often used in defining adjustment to illness, as positive adjustment is frequently said to involve an absence of psychological symptoms and good quality of life (Larsen & Lubkin, 2009).

As a result psychosocial outcomes have been widely investigated in a range of health conditions, including TBI and cardiac disorders. A number of psychological models can be applied to explain why some individuals adjust well to illness whereas others experience psychosocial difficulties. Cognitive appraisals are said to be an integral component in how individuals adjust to stressful situations or ill health (Lazarus & Folkman, 1984)., This suggests that how an individual appraises their situation, rather than the situation itself, results in psychological adjustment or psychological difficulties.

A popular model applied to explain adjustment to illness is Lazarus and Folkman's (1984) model of stress, appraisal and coping. This model suggests that illness, or the outcomes of illness, is a potential stressor and how individuals appraise the demands placed upon them and their ability to cope results in how they adapt to the illness (Larsen & Lubkin, 2009). Cognitive appraisal is central within the model, however it is also suggested that an individual's coping style and level of social support act as mediators for outcome.

Research has suggested that psychological distress can also impact on an individual's health condition, for example Shalev, Schreiber, Galai, and Melmed (1993) found that PTSD in individuals with medical conditions was associated with distress and disability and resulted in avoidance of care and poor treatment adherence. Research has also identified that depression can increase the risk of future cardiac incidents and mortality (e.g. Barth, Shumacher & Herrmann-Lingen, 2004; Penninx et al., 2001). It is therefore important to gain an understanding of the psychological impact of cardiac conditions, including cardiac arrest, in order to ensure adequate support is provided to survivors. Individuals who suffer anoxia as a result of cardiac arrest may also experience cognitive difficulties which could impact on the psychosocial outcome and influence the support they require. This is particularly important due to the increasing population of cardiac arrest survivors.

Individuals who have a cardiac arrest can experience a range of lifestyle changes such as being unable to return to employment due to ill health. Individuals who experience anoxia as a result of cardiac arrest may also experience cognitive impairments which mean they are unable to return to work. The employment status of individuals is often used in research as an indicator of whether individuals are able to return to their usual roles and activities. Return to employment has also been used in previous studies as an objective measure of an individual's quality of life (Sears & Conti, 2002). Being unable to return to work can have significant social implications for individuals such as financial implications and loss of social interaction and could impact on self-esteem.

Information about individuals' employment status following cardiac arrest has been reported in a number of studies and the proportion of participants reported to return to work have varied. Lundgren-Nilsson, Rosén, Hofgren & Sunnerhagen (2005) found that only 13% of participants were in employment with 53% receiving a disability pension or on sick leave. Hofgren, Lundgren-Nilsson, Esbjörnsson, and Sunnerhagen (2008) reported that only 29% of the participants who were of working age in their study had returned to work. There have also been reports that although people returned to work, many who did decreased the number of hours, including working part-time rather than full-time as they had previously done (Wachelder et al., 2009). Consideration should be given to the time between cardiac arrest and follow up when interpreting these results, as if this is extensive, change in employment may be due to other factors such as reaching the age of retirement or other age-related health issues.

Following cardiac arrest, physical ill health may result in individuals being increasingly dependent on others for completing daily activities. Individuals with cognitive difficulties resulting from anoxia during cardiac arrest may also have increased dependence on others due to difficulties such as memory, attention and planning etc. Information regarding living situation has been used in research as an indicator of whether an individual is independent or

whether they are dependent on others following brain injury or the development of health conditions.

There are varied findings regarding the living situation and independence in ADL following cardiac arrest. There are reports of 32% (Lundgren-Nilsson et al., 2005) and 36% (Hofgren et al., 2008) of individuals lived in supported accommodation following cardiac arrest. Pußwald, Fertl, Faltl and Auff (2000) found that 75% individuals in their study were dependent on others following cardiac arrest. Others have reported more positive outcomes with findings of 77% (Sunnerhagen, Johansson, Herlitz & Grimby, 1996) and 98% (Cronberg, Lija, Rundgren, Friberg & Widner, 2009) of participants living independently in their own homes following cardiac arrest and anoxia. In regard to ADL, a number of studies have identified that many individuals are dependent upon others following cardiac arrest with few being totally independent (Middelkamp et al., 2007; Hofgren et al., 2008)

Individuals who are unable to return to employment or are dependent on others for daily activities may appraise their situation negatively, perceiving great loss. This can result in feelings of hopelessness, low self-esteem and low mood (Sola & Bostwick, 2005). Loss of employment and dependence on others may also result in reduced participation in society as individuals may have a belief that they are unable to cope in demanding situations and avoid them (Ownsworth & Oei, 1998). The subsequent avoidance can then maintain feelings of low mood. Although there is limited research investigating the participation in society for individuals with anoxic brain injury resulting from cardiac arrest, some difficulties have been identified, for example, Middelkamp et al. (2007) found cardiac arrest survivors had significantly lower participation in society when compared to data published for individuals visiting a GP using the same measure in a previous study (Sibley et al., 2006) and Wachelder et al. (2009) reported that 74% of participants scored as impaired in social functioning.

From a cognitive appraisal model, how individuals interpret the cardiac arrest, their health and the resulting situation can result in psychological

difficulties. For example, cardiac arrest survivors who appraise their physical ill health as a threat, uncontrollable or as an indicator of their mortality may develop anxiety symptoms (Sola & Bostwick, 2005). This may result in them avoiding activities or situations they think will cause another cardiac arrest or impact on their health and this avoidance will act to maintain the anxiety. Individuals who make such appraisals may focus on physiological changes in their body and perceive these as cardiac symptoms resulting in and maintaining anxiety. Individuals who also experience anoxia as a result of cardiac arrest may have cognitive difficulties which impact on their appraisals of their ability to cope in situations which could result in anxiety. If individuals then avoid situations as a result of their perceived inability to cope, this would maintain the anxiety and limit independence and social functioning.

There are some limited findings investigating the presence of anxiety in cardiac arrest survivors. O'Reilly et al. (2004) reported that 30% of the cardiac arrest victims reported clinical levels of anxiety, compared to 7% of sufferers of myocardial infarction (although this was not a statistically significant difference). Wachelder et al. (2009) found anxiety symptoms were problematic for 13% of the participants in their study. Saner, Borner Rodriguez, Kummer-Bangerter, Schüppel & von Planta (2002) found no significant difference in anxiety symptoms between participants and a healthy matched control group; however this may have been due to the choice of measure as they used a QOL measure to identify anxiety symptoms.

Cardiac arrest survivors are often treated with an ICD and as the use of ICDs has been increasing, there has been an emergence of research investigating the outcome for individuals living with the device. Findings have suggested high levels of psychological problems are common in this population with anxiety in particular being a significant difficulty (e.g. Sears et al., 1999). Sears et al. (1999) reported rates of 13 to 38% of ICD patients experiencing clinically significant levels of anxiety. These difficulties have also been found to impact on the quality of life of individuals (Thomas et al.,

2006) with suggestions that poorer quality of life is associated with receiving shocks (Francis, Johnson & Niehaus, 2006; Sears & Conti, 2002).

How an individual appraises living with an ICD and the shocks received results in the emotional distress as, for example, individuals are more likely to experience distress if they interpret the shock as an indicator of worsening health rather than an effective intervention for their cardiac condition. Behavioural explanations can also be used to explain the presence of anxiety in ICD patients as the shocks received can be painful and frightening (Sola & Bostwick, 2005). From a classical conditioning paradigm, the ICD shocks are an unconditioned stimuli which elicit a fear response and when paired with an activity or situation in which the shocks occur, this becomes a conditioned stimulus and evokes anxiety. The activities or places where shocks are emitted are avoided which reinforces the anxiety and reduces participation in activity. Reduced participation in enjoyable activity can also result in low mood. The theory of learned helplessness (Abramson, Seligman & Teasdale, 1978) can also be used to understand the emergence of depression in individuals with ICDs. If individuals perceive the shocks as uncontrollable and develop negative beliefs about their health, this may result in feelings of hopelessness and low mood.

Individuals who perceive their situation following cardiac arrest as one of loss, for example loss of health and ability to complete tasks, may be more susceptible to low mood. They could also perceive their loss of ability to return to how they were prior to the cardiac arrest as a failure and avoid activities or situations for fear of failing which will impact on mood. The avoidance of situations and activities results in decreased social contact or support which is also associated with low mood.

O'Reilly et al. (2004) compared depression symptoms in individuals who had suffered an in-hospital cardiac arrest with individuals who had suffered a myocardial infarction and found a significant difference, with 15% of cardiac arrest survivors and none of the myocardial infarction comparison group reporting clinical levels of depression. Similar rates of depression symptoms

were reported by Wachelder et al. (2009) with 13% of the cardiac arrest survivors in their study experiencing symptoms of depression. Although they did not distinguish between anxiety and depression symptoms, Cronberg et al. (2009) also reported 14% of cardiac arrest survivors in their study experienced mood disorder.

Experiencing an out of hospital cardiac arrest is recognised as a significant event that can meet the Diagnostic and Statistical Manual of mental disorders (DSM-IV; American Psychological Association, 1994) criteria for post traumatic stress disorder (PTSD). Some researchers have found that individuals who have suffered cardiac arrest do experience PTSD symptoms. In O'Reilly et al's (2004) study 19% of the cardiac arrest survivors and 7% of the myocardial infarction survivors met diagnostic criteria for PTSD. Wachelder et al. (2009) measured symptoms of stress reaction using the Impact of event scale (Horowitz, Wilner, & Alvarez, 1979) and found that 13 individuals (21%) met the criteria for impaired levels of post traumatic stress symptoms. Ladwig et al. (1999) identified higher incidence of post traumatic stress symptoms in their study, with 42% of the participants in their study experiencing significant symptoms.

An explanation for why some individuals develop PTSD symptoms is how the event is appraised. If the cardiac arrest is appraised as a traumatic experience which was a significant threat to the individuals' life they can develop PTSD symptoms and these may be triggered by events such as ICD shocks or physiological changes.

Psychological distress and lack of social functioning can impact on an individual's QOL (Saner et al., 2002). The concept of QOL is multidimensional and vague, and as a result, there is no consensus on a single definition of QOL (Carr, Gibson & Robinson, 2001). Despite this, there has been a focus on the importance of understanding the impact on individuals' psychological, social and physical well being and therefore the measurement of quality of life in individuals with health conditions has increased (Moulaert, Wachelder, Verbunt, Wade & van Heugten, 2010). The

quality of life of individuals is measured in healthcare as a way of taking into account their views and in measuring the effectiveness of the medical care they received. Health related quality of life is commonly measured by using either a generic measure which measures different aspects of quality of life or a measure specific to a health condition.

Sunnerhagen et al. (1996) and Saner et al. (2002) both used the Nottingham Health Profile ([NHP] Hunt, McKenna, McEwen, Williams, & Papp, 1981) to assess QOL in individuals with anoxic brain injury following cardiac arrest. Both of these studies found QOL significantly differed between the participants and a general population; with significantly lower QOL in the energy and physical mobility dimensions in both of these studies, and in emotion and social isolation dimensions in one of the studies (Sunnerhagen et al., 1996). Sunnerhagen et al. (1996) also compared the QOL of the participants in their study to previous research using the NHP with individuals with myocardial infarction (Wiklund, Herlitz & Hjalmarsson, 1989). They found that individuals with anoxic brain injury following cardiac arrest had a lower QOL in emotion and social isolation but better QOL in energy, physical mobility and sleep.

Saner et al. (2002) used the Everyday-Life Questionnaire (Bullinger, Kirchberger & von Steinbüchel, 1993) alongside the NHP to assess quality of life and found that Participants had significantly lower QOL compared to the comparison group in physical functions, daily life and joy of life. Lundgren-Nilsson et al. (2005) also found that participants had reduced health related quality of life and lower life satisfaction, although there was some improvement from two weeks after the cardiac arrest to one year after.

Poor QOL in cardiac arrest survivors has been found to be associated with duration of post-traumatic amnesia and duration of coma (Middelkamp et al., 2007). Age and gender have also been found to be associated with QOL, with males and younger individuals reporting better QOL (Wachelder et al., 2009). Moulaert et al. (2010) investigated the factors involved in the

QOL in individuals with anoxic brain injury following cardiac arrest. They suggested that QOL is associated with cognitive difficulties, difficulties with ADL and psychological difficulties including anxiety, depression and post traumatic stress symptoms.

Rationale for the current study

Although the findings of the studies investigating the affective and social outcome of cardiac arrest have highlighted some of the difficulties individuals can experience, none have compared those that acquire anoxic brain injury as a result with those that do not. Individuals who experience anoxia have to adjust to life with acquired brain injury and the associated cognitive difficulties as well as the cardiac arrest.

Many of the studies discussed have not included a control group and have included participants who have had a cardiac arrest, without determining whether or not they have experienced anoxia. Others have excluded participants who have sustained anoxic brain injury or those who have not but none have compared these two groups. When a control group has been included, non-clinical populations have been used with only a small number comparing the outcome of cardiac arrest survivors to individuals with other cardiac problems. These comparison groups may not be entirely appropriate as cardiac arrest is a serious event for an individual.

Research evidence has identified that cardiac patients and individuals with brain injury experience psychosocial difficulties, however it is unknown whether individuals experiencing both experience more difficulties. Due to the increasing population of cardiac arrest survivors and those with anoxic brain injury as a result, it is important to understand the outcome for these individuals to allow adequate psychological and social support to be available to encourage adaptive adjustment. Therefore the aim of the current study is to explore the psychosocial outcome of anoxia following cardiac arrest compared with cardiac arrest not resulting in anoxia.

Extended Methodology

Epistemological position

A positivist epistemological position was taken when conducting the research and from this position it is viewed that following cardiac arrest individuals will or will not experience psychosocial difficulties and that these can be measured using scientific measures. As the research aimed to investigate a difference in psychosocial functioning between individuals who have suffered anoxia following cardiac arrest and individuals who have not, quantitative methodology was used. This is the most appropriate methodology as it allows a larger number of participants to be compared using quantitative measure of the areas of psychosocial functioning.

Participants

Two groups of participants were included in the study:

- Individuals who had an ICD implanted as treatment for out-of-hospital cardiac arrest which resulted in anoxia
- Individuals who had an ICD implanted and as treatment for out-of-hospital cardiac arrest which did not result in anoxia

The independent variable between the two groups was suffering anoxia, other variables such as suffering a cardiac arrest and having an ICD implanted was consistent across both groups.

Determining whether an individual has suffered anoxia is difficult; computed tomography (CT) scans are not effective in identifying the extent of anoxic brain injury, and although magnetic resonance imaging (MRI) scans are more sensitive at identifying the damage, in practice clinical information is often relied upon (Rabinstein & Resnick, 2009). The criteria used to establish anoxia in the current study was individuals identified at the time of cardiac arrest as having a Glasgow Coma Scale (GCS) score of less than 8 and requiring transfer to an intensive treatment unit (ITU) where they

received a period of therapeutic hypothermia to reduce neurological damage.

Inclusion criteria

Participants were included in the study between six-months and four years after suffering cardiac arrest. Initially it was proposed that individuals took part in the study between one and three years post cardiac arrest, however this was increased to allow for more potential participants. The relevant application was made to the Research Ethics Committee for this amendment. Six months following cardiac arrest was felt to be appropriate as it is often used in research as a criteria for long term follow-up (e.g. Cronberg et al., 2009). Research has also found that there are significant changes in functioning in the first six months following cardiac arrest but not following this (Kamphuis et al., 2002). The first six-months following receiving an ICD has also been said to involve the most adaptation to living with the device (Burke, 1996; May, Smith, Murdock & Davis, 1995).

Sample size

The intended sample size was determined using a power calculation to estimate the number of participants that would be required to produce a statistically significant result should one be present. Due to a lack of similar studies in the literature, a power analysis was calculated based on the effect size that would be preferred rather than effect sizes found in similar research. An effect size of 0.5 was chosen as it is considered to be a medium effect size (Cohen, 1992). A power value of 0.8 was used providing an 80% probability of detecting a difference and reducing the risk of a type two error (Cohen, 1992). The power calculation was performed using Gpower 2 and it was calculated that 102 participants would be required in the study, 51 in each group. The data from the calculation can be seen below:

Effect size - 0.5

Alpha - 0.05

Power - 0.8

Delta - 2.5249

Critical t (40) - 1.6602

Total sample size - 102

Measures

A selection of self-report questionnaires was used to measure outcome. Measures which are brief in nature were selected so that taking part in the study was not time consuming for participants.

Quality of Life

Burckhardt, Woods, Schultz, and Ziebarth's (1989) version of the Quality of Life Scale (QOLS) was used as a measure of the participant's quality of life. The measure was based on the original version devised by Flanagan (1979) with changes being the inclusion of an extra item to extend its use to individuals with chronic illness and changes to the scale used (Burckhardt & Anderson, 2003). It is a 16-item questionnaire which asks how satisfied an individual is, using a seven-point scale (1-7), in relation to the following items:

- Material comforts, home, food, conveniences, financial security
- Health - being physically fit and vigorous
- Relationships with parents, siblings and other relatives. Communicating, visiting, helping
- Having and rearing children
- Close relationships with spouse or significant other
- Close friends
- Helping and encouraging others, volunteering, giving advice
- Participating in organisations and public affairs
- Learning- attending school, improving understanding, getting additional knowledge

- Understanding yourself - knowing your assets and limitations, knowing what life is about
- Work - job or in home
- Expressing yourself creatively
- Socializing - meeting other people, doing things, parties, etc
- Reading, listening to music, or observing entertainment
- Participating in active recreation
- Independence, doing for yourself

A number of studies have found the QOLS to have good reliability, with findings suggesting both internal consistency (e.g. $\alpha = 0.82$ [Burckhardt, Archenholtz & Bjelle, 1992]) and test-retest reliability (Burckhardt et al., 1989). The measure is also considered to have good convergent and discriminant construct validity (Burckhardt et al., 1989; Burckhardt, Anderson, Archenholtz & Hagg, 2003).

There are numerous measures available to assess QOL, with one review reporting 150 different measures (Gill & Feinstein, 1994). The measures available are said to fall into two groups, based on the concepts used in attempts to define QOL (Muldoon, Barger, Flory & Manuck, 1998). The first group are based on more objective ways of defining QOL by looking at aspects such as levels of functioning and health status, the second group are based on definitions which see QOL as a subjective perception of overall well-being.

The studies that have assessed QOL in individuals with anoxic brain injury following cardiac arrest have tended to use the more objective, health status and function focussed measures such as the SF-36 health survey (Brazier et al., 1992) and National Health Profile ([NHP] Hunt et al., 1981). The NHP is widely used as a measure of health-related QOL and is one of the most commonly used general measures in the UK; however, it has received criticism for assessing whether an individual has a health problem rather than their QOL (Dempster, Bradley, Wallace & McCoy, 1997). Similarly other objective QOL measures have been criticised for measuring symptoms

and functional status which impact on QOL rather than QOL itself (Burckhardt & Anderson, 2003).

The QOLS fits with definitions of QOL which stress the subjectivity involved and includes a range of factors rather than just health related concepts (Burckhardt & Anderson, 2003). A subjective measure of QOL was selected as it allows a measure of the individual's appraisal of their QOL in the context of their health and wider aspects of their life.

The QOLS was considered to be an appropriate measure for the current study as it has been found to be useful for individuals with a range of chronic health conditions including cardiac conditions (Burckhardt & Anderson, 2003). The questionnaire takes approximately five minutes to complete (Burckhardt & Anderson, 2003) so was not time consuming for the participants.

Social functioning

The Social Functioning Questionnaire ([SFQ] Tyrer, 1990) was selected as a measure of perceived social functioning. The SFQ is a self-report scale which has eight items; each scored on a four-point scale (0-3) and was developed from a semi-structured interview schedule, the Social Functioning Schedule (SFS). The scale includes questions relating to:

- Work & home tasks
- Financial issues
- Relationships with family
- Sexual activities
- Social contacts
- Social activities

There are reportedly over 40 available measures of social functioning which are based on either norm-based criteria or subjective views of functioning (Tyrer, Karlsen & Crawford, 2002). Measures of individual's subjective views of their social functioning are becoming the preferred type of measure as

they move away from the idea that there is a desired or 'normal' level of functioning (Tyrer et al., 2005). A subjective measure of social functioning was selected for the current study for this reason.

Other subjective measures of social functioning include the Social Adjustment Scale Self-Report (Weissman & Bothwell, 1976) and the SF-36 (Ware & Sherbourne, 1992), which are the most frequently used measures in the literature (Tyrer et al., 2005). However, these measures were not selected as they are time consuming, taking up to 20 minutes each to complete whereas the SFQ is estimated to take less than four minutes to complete (Tyrer et al., 2005). The SFQ has also been found to have good reliability and validity (Tyrer et al., 2005).

Depression and anxiety symptoms

Symptoms of depression and anxiety were measured using the Hospital Anxiety and Depression Scale (HADS) developed by Zigmond and Snaith (1983). The tool was developed to assess anxiety and depression in clinical populations and is suitable for use in individuals with a brain injury.

The HADS has been found to have good reliability and validity when used to assess anxiety and depression in medical patients (Herrmann, 1997). Bjelland, Dahl, Haug, and Neckelmann (2002) reviewed 747 studies that had used the HADS to evaluate the validity of the measure. The HADS was reported to demonstrate good to very good concurrent validity when compared to other measures, such as the Beck Depression Inventory and the State Trait Anxiety Inventory (Depression= 0.6 & Anxiety= 0.8). They also reported good discriminant validity between the anxiety and depression factors and good internal consistency (Depression, α = 0.68 – 0.93; Anxiety, α = 0.67 – 0.9). They also found that this was the case when used in different populations including the general population, somatic, psychiatric and primary care populations.

The HADS was selected as it is frequently used in clinical practice and has been used in other studies investigating the outcome of anoxia mentioned in the background section (O'Reilly, Grubb & O'Carroll, 2004; Ladwig et al., 1999) which allows for comparisons to be made with the results from the current study and previous findings. The HADS is reported to take between two and five minutes to complete (Snaith, 2003) which again makes this a useful measure for the current study.

Post traumatic stress symptoms

Post traumatic stress symptoms were measured using the Impact of Event Scale- Revised ([IES-R] Weiss & Marmar, 1997). This measure was based on the Impact of Event Scale (Horowitz, Wilner, & Alvarez, 1979) but includes seven new items exploring hyper-arousal symptoms as well as avoidance and intrusion symptoms (Weiss, 1997). The IES-R has 22 items which are rated on a five point scale (0-4) ranging from 'not at all' to 'extremely'.

This measure has previously been used with cardiac patients (Baumert, Simon, Gündel, Schmitt & Ladwig, 2003) making it a suitable measure for the current study. The IES-R has been found to have good reliability, particularly for the intrusion ($\alpha = 0.80$) and avoidance ($\alpha = 0.81$) subscales, with the hyper-arousal subscale ($\alpha = 0.66$) having a lower reliability (Baumert et al., 2003). High levels of internal consistency (intrusion, $\alpha = 0.90$ & 0.94 ; avoidance, $\alpha = 0.87$ & 0.86 ; hyper-arousal, $\alpha = 0.91$ & 0.85 ; total, $\alpha = 0.96$ & 0.95) have also been reported (Beck et al., 2008; Creamer, Bell & Failla, 2003). Beck et al. (2008) assessed the discriminant validity of the scale by comparing the scores of individuals with PTSD and without PTSD and found significant differences (Intrusion, $t(180) = -5.88$, $p < 0.0001$, 16.1 % variance accounted for; Avoidance, $t(180) = -4.18$, $p < 0.0001$, 8.9% variance; Hyper-arousal, $t(180) = -6.16$, $p < 0.0001$, 17.4% variance). In assessment of concurrent validity, the IES-R was found to be highly correlated with scores on the PTSD Checklist (Weathers, Litz, Herman, Huska, & Keane, 1993)

(total score= 0.84, $p < 0.001$; intrusion= 0.86, $p < 0.001$; avoidance= 0.66, $p < 0.001$; hyper-arousal= 0.79, $p < 0.001$ [Creamer et al., 2003]).

There are variable findings on the factor structure of the IES-R, Creamer et al. (2003) found this was not consistent across the subscales and described how this was comparable to other similar measures. They suggested this may be due to the validity of the DSM-IV criteria on which the subscales are based and argued that the measure may appropriately assess the constructs involved in post traumatic stress which is of more value than fitting with diagnostic criteria that changes. Beck et al. (2008), however, found support for the factor structure of the IES-R and suggested that the different findings may have been due to them having a more homogenous sample than Creamer et al. (2003).

Subjective rating of memory difficulties

The Everyday Memory Questionnaire-Revised ([EMQ-R] Royle & Lincoln, 2008) was used in the current study which is a revision and shorter version of the Everyday Memory Questionnaire (Sunderland, Harris & Baddeley, 1983). The EMQ-R is a 13-item self report measure on which individuals rate on a five-point scale (0-4) the frequency of memory failures. The measure has been described as a measure of metamemory rather than of specific memory difficulties and assesses whether an individual has perceived difficulties in memory and attention (Royle & Lincoln, 2008). Royle and Lincoln (2008) suggest that the EMQ-R is used alongside objective measures of memory, however this was not felt necessary in the current study as the individuals' psychosocial outcome was of interest rather than specific cognitive difficulties and their perception of memory difficulties was more relevant.

The psychometric properties of the original version of the measure have been more widely explored than the revised version. Royle and Lincoln (2008) found the EMQ-R to have high internal consistency ($\alpha = 0.89$).

Subjective rating of executive difficulties

A subjective rating of executive difficulties was gained using the Dysexecutive questionnaire (DEX) from the Behavioural Assessment of the Dysexecutive Syndrome (Burgess, Alderman, Wilson, Evans & Emslie, 1996). The questionnaire was completed by the participants and a family member. There are 20 items included in the questionnaire which consider emotional or personality changes, motivational changes, behavioural changes and cognitive changes.

The DEX has been found to have high internal consistency (Cronbach α = .93) and moderate construct validity when compared to Dubois, Slachevsky, Litvan and Pillon's (2000) Frontal Assessment Battery (Shinagawa et al., 2007).

Demographic information

The demographic information collected was the participants' age, gender, employment status and living arrangement. Living arrangements may provide an indication of the presence of social support for the participants.

Clinical information

Clinical data was obtained from the participants' case notes by the Consultant Cardiologist. This included the date and time of the cardiac arrest and the time between cardiac arrest and defibrillation. Information about the duration of coma and the Glasgow Coma Scale score on arrival at Accident and Emergency was also obtained to provide a means of estimating the severity of anoxia.

Method

Ethical approval was gained from the Derbyshire Research Ethics Committee using the Integrated Research Application System (IRAS). The

study was also granted ethical approval from the University of Lincoln Ethics committee.

Participants were identified by Consultant Cardiologists at two NHS Trusts in the UK from existing databases of patients who had an ICD implanted. Inclusion and exclusion criteria were identified from individuals' case notes by the Consultant Cardiologists and suitable participants were determined. Potential participants were sent an assessment pack by post containing a letter from the Consultant Cardiologist introducing the study, a participant information sheet, a sheet requesting demographic information, the self-report questionnaires (QOLS, HADS, SFQ, IES-R, DEX and EMQ-R) and a stamped return envelope addressed to the researcher. The process of participant recruitment is summarised in figure 1.

The participant information sheet contained detailed information about the study and what would be required if they decided to take part and the questionnaires, which together allowed potential participants to make an informed choice about whether to consent to taking part or not. As the information and questionnaires were sent and returned by post, participants were able to take as much time as required to decide whether to take part. Consent was implied by the returning of the questionnaires, participants were not asked to sign to provide consent to maintain their anonymity. Participants were informed they could withdraw from the study up until the information was prepared for publication by contacting the researcher and providing their participant code.

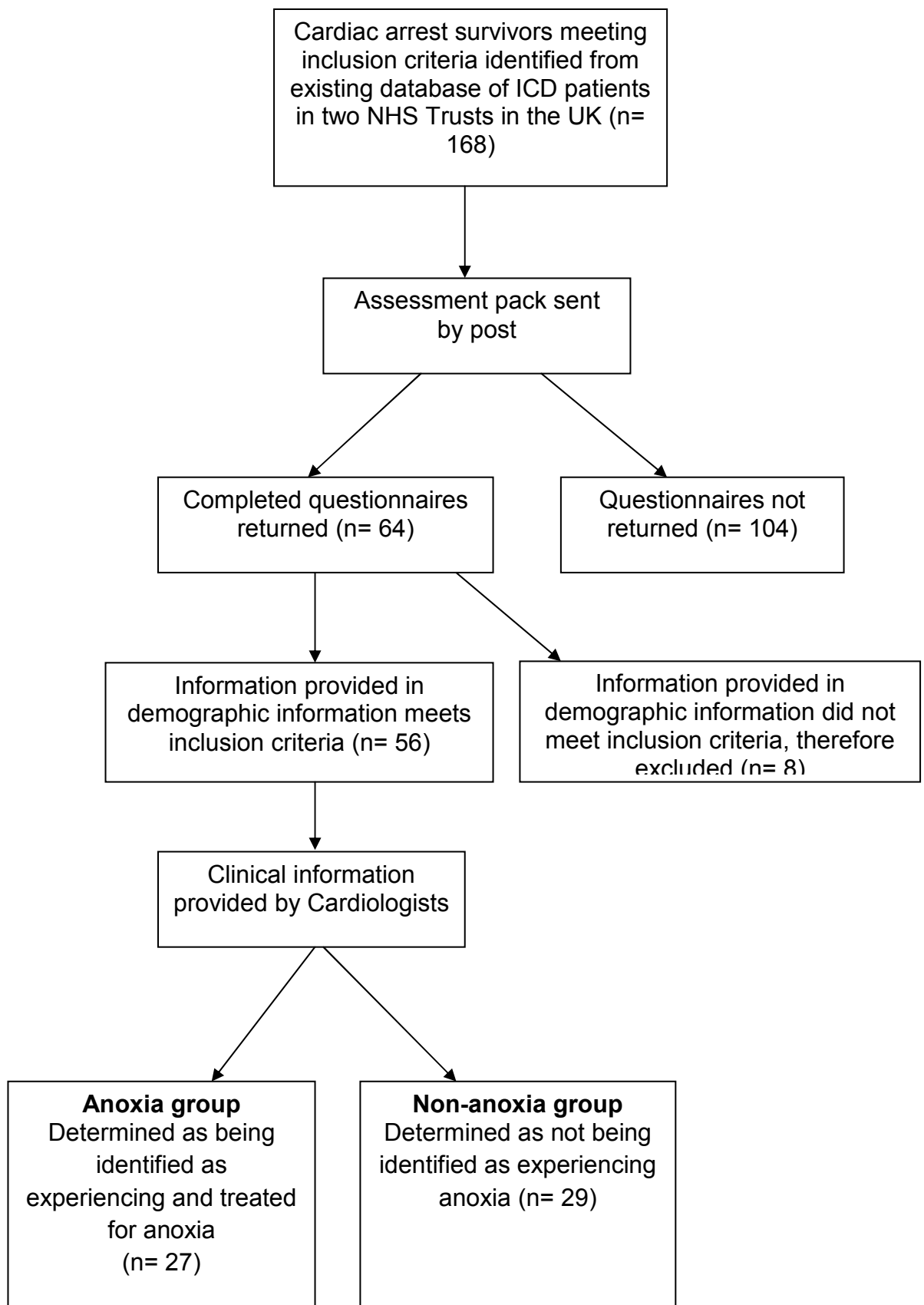
Participants who consented to taking part in the study completed the demographic information and the six self-report measures and returned them using the provided envelope. The total time for participants to complete the questionnaires was estimated to be approximately 30 minutes. The DEX was also completed by someone who knows the participant well such as a partner, family member or friend. It is estimated that it would have taken approximately five minutes for this questionnaires to be completed.

The clinical and demographic information and the data from the self-report measures collected in the study did not include identifiable information such as individuals' names, addresses or contact details to ensure anonymity. The data collected in the study was coded in correspondence with the demographic and clinical data so that they could be matched when the questionnaires were returned. As the questionnaires and information sheets were sent by the Consultant Cardiologists, the researcher did not require access to their names and contact details at any point in the study. The case notes were also only viewed by the Consultant Cardiologists who was already involved in the individuals' care.

Analysis

The measures were scored in accordance with the standardised instructions. The data was analysed using the Statistical Package for the Social Sciences (SPSS). Multiple analyses of variance (MANOVA) were used for the primary analysis to compare the two groups across the measures.

Figure 2 Recruitment of participants



Extended Results

Missing data

It is common in self-report measures to have missing data. The number of questions not answered and the percentage of the whole data for that measure can be seen in table 6.

Table 9 Missing data

Measure	Number of missing answers
Social Functioning Questionnaire	4 (1.5%)
Impact of Event Scale- revised	2 (<1%)
Quality of Life Scale	12 (2%)
Hospital Anxiety and Depression Scale	7 (1.5%)
Everyday Memory Questionnaire-revised	0
Dysexecutive Questionnaire (self)	0
Dysexecutive Questionnaire (Independent)	2 (<1%)

There are numerous ways of managing missing data including deletion or imputation with a calculated estimate (Fox-Wasylyshyn & El-Masri, 2005). There are a number of suggestions regarding the amount of missing data that can be included in a study without impacting on the results which range from 10% (Cohan, 1983) to 40% (Raymond & Roberts, 1987). The deletion of cases involving missing data from analysis has the disadvantage of reducing the statistical power. Due to the small sample size and low percentage of missing data (<2%) missing data in the current study was replaced with an estimate rather than excluded. Missing data was replaced with a mean for the participant on the scale or subscale which was felt to be more appropriate than using the mean of the group as it acknowledges the differences between cases. This method has been found to be a robust method when up to 20% of data is missing (Roth, Switzer & Switzer, 1999).

Multiple Analysis of Variance (MANOVA)

It is an assumption of a MANOVA that the data is normally distributed. To test this, the skewness and kurtosis was explored and a Shapiro-Wilk test was performed in SPSS (see table 7). The Shapiro-Wilk tests suggested that the data for IES-R and the depression subscale of the HADS were significant suggesting the data was not normally distributed. The Shapiro-Wilk test has been described as very sensitive, therefore the skewness and kurtosis of the data was explored. This confirmed that the IES-R scores for the non-anoxia group were not normally distributed, however the depression scores did not appear to be.

Despite the potential violation of normality on the depression score of the HADS based on the Shapiro-Wilk test, it has been suggested that MANOVA is still a valid test when there are modest violations of this assumption as it is robust to such violations, particularly if there are at least 12 participants in each group (Dancy & Reidy, 2002) and if groups are of relatively equal size (i.e. one group is not more than 1.5 times larger than the other). There is the option of transforming data into a normal distribution, however this is often criticised as it may impact on the results. Therefore, as a MANOVA is robust to moderate violations of the assumptions, the test was used to analyse the data, although the IES-R was not included in the calculation as a violation of normality for this test was identified in both the Shapiro-Wilk test and from the Skewness and Kurtosis. It was felt that a MANOVA would be an appropriate test to use as an equivalent non-parametric test is not readily available and using a multivariate test rather than numerous bivariate tests reduces the chance of a type 1 error. MANOVA also allows any differences between the groups along combinations of dependent variables to be explored. The IES-R scores of the two groups were compared separately using a Mann-whitney u test.

Homogeneity of variance-covariance matrices is also an assumption that should be met for a MANOVA. A Box's M Test was performed in SPSS to test this assumption and as the test was not significant ($F(10, 13768.87) =$

0.944, $p = 0.491$) this assumption was met. Mahalanobis distance was calculated to identify multivariate outliers and this identified that there were none ($d^2 < 0.001$).

Effect size for the MANOVA was calculated in SPSS and for multivariate tests this is calculated using partial eta squared. There are numerous calculations available for computing effect size including calculations of the standardised mean difference, such as Cohen's d , or of the proportion of variance accounted for by the independent variable such as the partial eta squared calculation used. The different types of effect size should be interpreted in different ways. Cohen (1988) suggested that for Cohen's d effect sizes, a large effect size is 0.80 or greater, a medium effect size is 0.50 and a small effect size is 0.20 and for partial eta squared calculations a 0.01 to 0.06 is a small effect, 0.06 to 0.14 is a medium effect, and 0.14 and greater is a large effect.

In MANOVA, as well as the multivariate statistic, multiple univariate ANOVAS are also computed to compare both groups on each dependent variable. When the multivariate result is significant, it is recommended that the ANOVAS are examined to identify on which dependent variables the groups differ. Due to the increased risk of a type I error occurring through conducting multiple tests, it is often suggested that a post hoc test is used, such as the Bonferroni adjustment. Others criticise this method for being unnecessary, for example Perneger (1998) highlights that the assumption on which Bonferroni correction is based is that all null hypotheses tested are true concurrently, whereas researchers are often interested in each variable individually. The use of Bonferroni adjustment also increases the risk of a type II error occurring and as a result it is often recommended that rather than using Bonferroni adjustment, the tests used and findings should be reported so that the reader is aware and can interpret the data appropriately. For these reasons, a Bonferroni correction was not used in the current study.

Table 10 Shapiro-Wilk test of normality, skewness and kurtosis

Measure	Group	Shapiro-Wilk	Skewness	Kurtosis
SFQ	Anoxia	0.951	0.262	-0.982
	Non-anoxia	0.939	0.527	-0.407
IES-R (T)	Anoxia	0.890*	1.132	0.820
	Non-anoxia	0.824*	1.718	3.280
IES-R (A)	Anoxia	0.900*	0.990	0.337
	Non-anoxia	0.804*	1.863	4.288
IES-R (I)	Anoxia	0.887*	0.941	-0.009
	Non-anoxia	0.844*	1.313	1.356
IES-R (H)	Anoxia	0.827*	1.207	0.348
	Non-anoxia	0.746*	1.582	1.515
QOLS	Anoxia	0.972	-0.012	-0.508
	Non-anoxia	0.972	-0.099	-0.805
HADS (T)	Anoxia	0.945	0.252	-1.099
	Non-anoxia	0.958	0.653	0.420
HADS (D)	Anoxia	0.907*	0.300	-1.374
	Non-anoxia	0.915*	0.558	-0.769
HADS (A)	Anoxia	0.926	0.405	-0.529
	Non-anoxia	0.939	0.744	0.833
EMQ-R (T)	Anoxia	0.895*	0.914	0.159
	Non-anoxia	0.779 *	1.584	1.613
EMQ-R (R)	Anoxia	0.817*	0.534	0.878
	Non-anoxia	0.805*	1.341	0.693
EMQ-R (A)	Anoxia	0.819*	1.340	1.170
	Non-anoxia	0.756 *	1.620	2.188
DEX (S)	Anoxia	0.898*	1.314	2.066
	Non-anoxia	0.937	0.886	1.586
DEX (I)	Anoxia	0.845*	1.373	1.702
	Non-anoxia	0.921*	0.234	-1.287

* significant

SFQ, social Functioning Questionnaire; IES-R, Impact of Event Scale- Revised; IES-R (A), avoidance subscale; IES-R (I), intrusion subscale; IES-R (H), hyper-arousal subscale; QOLS, Quality of Life Scale; HADS, Hospital Anxiety and Depression Scale; HADS (D), depression subscale; HADS (A), anxiety subscale; EMQ-R (T), Everyday Memory Questionnaire- revised (total score); EMQ-R (R), retrieval subscale; EMQ-R (A), attentional tracking subscale; DEX (s), Dysexecutive Questionnaire (s) self rater, (I) independent rater

Extended Discussion

The current findings identified that psychosocial outcome is worse for cardiac arrest survivors who experience anoxia as a result compared to those who do not. It is proposed that this is due to those individuals having to adjust to life with anoxic brain injury and resulting cognitive difficulties as well as living with the physical consequences of a cardiac arrest and ICD. The current findings challenge some of the previous research proposing cardiac arrest survivors experience significant psychosocial difficulties, as the current results suggest that cardiac arrest survivors who experience anoxia have difficulties, but individuals without anoxia did not have significant psychological difficulties. Previous studies may have identified psychosocial difficulties in their samples as they included individuals with anoxia, even though this was not always specified and individuals without anoxia were also included.

Although the two groups were well matched for age and time since cardiac arrest, there were more females in the anoxia group (52%) than in the non-anoxia group (17%). It has previously been suggested that there are gender differences in the occurrence and outcome of CA, although there have been varied findings.

There is a higher incidence of cardiac arrest in males (Vukmir, 2003; Kim, Fahrenbruch, Cobb & Eisenberg, 2001). It has been suggested that females are more likely to survive cardiac arrest than males (Akahane et al., 2011; Herlitz et al., 2004) however others suggest that females have higher rates of pre-hospital resuscitation but equivalent or lower rates of survival to discharge from hospital (Perers et al., 1999; Kim et al., 2001). Proposed explanations for this have included females having cardiac arrest at an older age than males and fewer cardiac arrest in females being witnessed and therefore less experience of bystander CPR (Kim et al., 2001; Perers et al., 1999).

There is limited research investigating gender differences in outcome following cardiac arrest. In regard to gender and cognitive outcome, a number of studies have found no difference between males and females (Roine et al., 1993; Mouleart et al., 2009), however Wachelder et al. (2009) found that male cardiac arrest survivors had better cognitive functioning than females. Findings on gender and psychosocial outcome is limited and varied, for example Kamphuis et al. (2002) found there were no gender differences in psychological well-being and gender has not been found to be associated with QOL (Hsu, Madsen & Callahan, 1996). Other studies have identified gender differences, such as males having better QOL but lower participation in society and greater impairments in ADL (Wachelder et al., 2009). Females have also been found to have poorer physical functioning following cardiac arrest in one study (Von Alem, Waalewijn, Kosler & de Vos, 2004).

There were no gender differences on any of the measures in the current study. This would suggest that, despite there being more females in the anoxia group, it is unlikely that this would the differences identified between the two groups.

As would be expected based on previous findings and psychological literature regarding co-morbidity of psychological disorders, there was a highly significant correlation between symptoms of anxiety and depression. These were also found to be associated with social functioning and QOL. Psychological theory can be used to consider this correlation as evidence suggests that engaging in fewer activities has a negative impact on mood and that low mood and anxiety can cause low motivation and reduce engagement in activities. This information is useful for identifying psychosocial difficulties in cardiac arrest survivors and for intervention and rehabilitation of both cardiac patients and those with anoxic brain injury as a result. Anxiety, low quality of life and lack of social participation in ICD patients has been considered from a behavioural approach (Sears & Conti, 2002). It has been suggested that classical conditioning can be used to

explain avoidance of certain situations and behaviours as they are associated with the anxiety and fear response when a shock is administered.

Surprisingly, none of the scores were correlated with GCS score, which has frequently been identified as a reliable prognostic indicator of brain injury severity and to be associated with difficulties following brain injury (Schefold et al., 2009). The lack of association between GCS score and psychosocial difficulties may also have been due to the similarity in GCS score within each group. As GCS score is a main indicator of ABI, these were indicative of the group in which the participants were in. All individuals in the anoxia group had a GCS score of below eight, with the majority of their GCS scores being three. All individuals in the non-anoxia group had a GCS score of above eight, with many of these participants having a GCS of 15. This may also be explained by the time the GCS score used in the current study was determined as the GCS scores used were the ones that were recorded at the time of cardiac arrest as these were most reliably available. Findings have suggested that repeated GCS scores determined at numerous times following cardiac arrest are more reliably predictive of outcome (Thatcher, Canter, McAlaster, Geister & Krause, 1991).

Information regarding living situation and employment was gathered in the current study and although this can provide an indication of independence and level of activity, it is difficult to come to conclusions about this as information about living arrangements and employment prior to the cardiac arrest is not known. Many of the participants were retired, which may be due to age rather than health reasons as only one person indicated this was the case. Any change in living situation or employment may have been more indicative of psychosocial difficulties.

Despite the significant difference between the two groups being identified, the present study would have benefited from a larger sample size. The response rates noted may have been due to the questionnaires being sent by post as research has suggested that postal surveys often have poor response rates (Nakash, Hutton, Jorstad-Stein, Gales & Lamb, 2006). To

comply with the regulations outlined by the ethics committee, potential participants were informed in the participant information sheet that they would not be contacted again regarding the study if they chose not to participate, as a result follow up letters were not sent out. Studies have identified that following up or sending another copy of the questionnaire to individuals who do not respond increases response rates (Edwards et al., 2002).

Identifying anoxic brain injury is difficult without neuro-imaging evidence, and even then it can be inconclusive. This may be a reason for the lack of research comparing cardiac arrest survivors with and without anoxic brain injury as a result. The current study relied on existing records of the clinical information used at the time of cardiac arrest to determine whether participants suffered probable anoxic brain injury or not. Although this information may not be fully reliable, this is representative of clinical situations, where clinical information is used to determine neurological damage (Rabinstein & Resnick, 2009) and the best course of treatment for an individual. The judgement of medical professionals at the time of cardiac arrest is the best indicator of outcome when more advanced techniques such as neuro-imaging are not available.

Caution should be taken when comparing the results with previous findings, as all participants in the current study received an ICD as a preventative intervention for further cardiac events. As individuals living with ICDs have been found to experience psychosocial difficulties (Sears et al., 1999; Francis, Johnson & Niehaus, 2006; Thomas et al., 2006) it is difficult to identify whether this contributes to the difficulties noted; in previous studies participants have not had an ICD or this information is not provided. Similarly, the anoxia group in the current study underwent a period of therapeutic hypothermia in an attempt to reduce neurological damage. Until there is further evidence of the impact this has on outcome for individuals caution should be taken when comparing the findings to studies in which cardiac arrest survivors did not have a period of therapeutic hypothermia.

Reflections

The research topic was selected as I have a specific interest in neuropsychology which developed through my experience of working as an assistant psychologist in brain injury rehabilitation. I was interested in investigating the psychosocial impact of anoxic brain injury as during my time working in brain injury rehabilitation, I worked with a number of individuals who had anoxic brain injury and discovered that such injuries resulted in a range of significant cognitive difficulties, which is possibly due to the diffuse nature of such injury. I also have an interest in how individuals adapt to living with the effects of a brain injury and also in psychological disorders people with brain injury develop.

The research process for the current study has generally been enjoyable. The help and support of Dr Staniforth, Consultant Cardiologist and Dr Vesey, Consultant Clinical Neuropsychologist, has been invaluable. Their input into the initial design of the study allowed for a proposed study that was both practical and achievable and I feel this led to the avoidance of significant problems throughout the process. The support that Dr Staniforth and Dr Vesey have provided has shown that they are invested in the study which has confirmed the clinical implications of it.

As well as the investment of other professionals, some of the returned questionnaires had additional notes written on, explaining that they were experiencing psychosocial difficulties, for which they were not receiving support, and being thankful for the acknowledgement of the need for research in this area. Although this was reassuring of the implications of such research, I felt in a difficult position as a researcher to manage such comments. The participants were anonymous to me; however some were expressing a need for support. All potential participants were advised to contact their GP or alternative sources for advice or support if they were experiencing psychological difficulties, this information will again be reiterated when a summary of the findings is sent to those participants that requested one.

Although the IRAS application was time-consuming and at times confusing, I found the process of gaining ethical approval straightforward. I found attending the Ethical review meeting particularly helpful in both experiencing explaining and justifying my research project and in gaining useful, practical advice. The process for gaining Research and Development approval was more problematic and I found this frustrating as it held up the start of data collection, reducing the time for analysis and report writing.

A main limitation of the current study was the initial lack of power due to the low response rate and limited number of potential participants. To overcome some of these difficulties, it was decided that the inclusion criteria would be adapted so individuals who experienced cardiac arrest between six months and four years previously would be included rather than between one and three years. There were limited options in how we could attempt to increase the response rate, as it was stated in the participant information sheet that individuals not wanting to take part in the study would not be contacted again. Although this was so individuals did not feel pressured into participating, this meant that we could not send reminders which may have prompted people into taking part. The method of sending questionnaires by post was useful as it was less time consuming, however this again may have contributed to the low response rate. It was initially considered that individuals would have been asked in person to take part in the study when they attended hospital for their ICD check up, however this was not practical during the time scale of the study as ICD patients usually attend appointments every six months or yearly. A Cardiologist within another NHS Trust was identified who was willing and able to identify potential participants to increase the sample of the study. Obtaining relevant approval from the local Research and Development department to recruit participants from the second NHS Trust was a lengthy process and held up sending out questionnaires to participants.

Although the focus of the research is psychological, it is within a specific medical area and I have therefore had to gain some knowledge of this to understand the key concepts. The Consultant Cardiologist's involvement

has been valuable in this and in ensuring the research is relevant in this field as well as clinical psychology.

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Appendices

Appendix A Search terms for systematic review

Search terms used in medline search. The search strategy was then altered appropriately for search in PsychINFO, Embase and web of science databases.

- 1 psycho*.mp.
- 2 social.mp.
- 3 mood disorder.mp. or Mood Disorders/
- 4 anxiety*.mp.
- 5 depress*.mp.
- 6 "post traumatic stress".mp.
- 7 "quality of life".mp.
- 8 functioning.mp.
- 9 "Activities of Daily Living".mp.
- 10 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
- 11 hypox*.mp.
- 12 limit 11 to (humans and "all adult (19 plus years)")
- 13 anox*.mp.
- 14 limit 13 to (humans and "all adult (19 plus years)")
- 15 ischemi*.mp.
- 16 limit 15 to (humans and "all adult (19 plus years)")
- 17 "brain injury".mp.
- 18 limit 17 to (humans and "all adult (19 plus years)")
- 19 Hypoxia-Ischemia, Brain/ or "brain damage".mp. or Brain Ischemia/
- 20 limit 19 to (humans and "all adult (19 plus years)")
- 21 "cerebral injury".mp.
- 22 limit 21 to (humans and "all adult (19 plus years)")
- 23 12 or 14 or 16 or 18 or 20 or 22
- 24 "cardiac arrest".mp.
- 25 limit 24 to (humans and "all adult (19 plus years)")
- 26 "heart arrest".mp.
- 27 limit 26 to (humans and "all adult (19 plus years)")
- 28 "cardiopulmonary arrest".mp.
- 29 limit 28 to (humans and "all adult (19 plus years)")
- 30 25 or 27 or 29
- 31 10 and 23 and 30

Appendix B Ethics favourable opinion letter

Dear Miss Wilson

Study Title: The psychosocial outcome of anoxic brain injury following cardiac arrest
REC reference number: 10/H0401/69

Thank you for your letter of 15 September 2010, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

For NHS research sites only, management permission for research ("R&D approval") should be obtained from the relevant care organisation(s) in accordance with NHS research governance arrangements. Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at <http://www.rdforum.nhs.uk>.

This Research Ethics Committee is an advisory committee to East Midlands Strategic Health Authority
*The National Research Ethics Service (NRES) represents the NRES Directorate within the
National Patient Safety Agency and Research Ethics Committees in England*

Appendix C Letter of invitation

Dear (patient's name)

I am writing to invite you to take part in a study that is being conducted by the Department of Cardiology in collaboration with the Department of Clinical Psychology. It is important that research is carried out within the NHS to provide more information about health conditions and ensure that the services offered meet the needs of patients. This research project is following up individuals who have had a cardiac arrest.

A detailed Participant Information sheet is enclosed which will give you more information about this study. If you decide to take part there is a general information sheet and a number of short questionnaires for you to complete and return in the enclosed stamped, addressed envelope.

I would be grateful if you would take time to read the information and consider taking part. If you have any questions or comments about this research project, please feel free to contact me or the people involved in the study, whose details are on the participant information sheet.

Yours Sincerely

Dr
Consultant Cardiologist

Appendix D Participant Information Sheet

Code:

Participant information sheet

I am conducting a research study as part of my Doctoral training as a Clinical Psychologist and would like you to take part. Please read the following information and take time to consider it before deciding whether you would like to take part or not. After reading this you should have detailed information about the purpose of the study and what taking part will involve.

What is the purpose of the study?

The study will look at the psychological and social impact of anoxia (damage to the brain caused by lack of oxygen) following cardiac arrest. It will look at the difficulties that people may have as a result of experiencing anoxia after cardiac arrest compared to individuals who have had a cardiac arrest but not suffered anoxia.

Why am I being asked to take part?

You are being asked to take part as you had a cardiac arrest within the last four years and may or may not have had anoxia as a result so I would like you to be part of one of the two groups. I hope to include approximately 50 people in each group.

Do I have to take part?

You do not have to take part in this study if you decide you do not want to. Your decision will not affect your usual care with cardiology in any way.

What will I have to do if I take part?

Six short questionnaires and a short form have been included in this pack and if you decide to take part all you will be asked to do is complete them and return them in the stamped addressed envelope provided. It is important that you answer the questions as accurately and as honestly as possible. There is also one short questionnaire to be completed by someone who knows you well, such as a family member or friend.

Each questionnaire will take approximately five minutes to complete so taking part in the study should take approximately 30 minutes.

Please return the questionnaires by **(date will be given- one month after questionnaires are sent)**

What do I do if I do not want to take part?

If you decide that you do not want to take part in the study you do not have to do anything. You can either return the blank questionnaires in the stamped, addressed envelope provided or throw them away. You will not be contacted again about this research.

What if I decide to take part and return the questionnaires but then change my mind?

If you decide that you no longer want to take part in the study after returning the questionnaires, you can contact me and quote the code at the top of this information sheet and all of your data will be removed from the study. Once the research is completed it will be submitted for publication and your data can be removed anytime up until it is written up ready for publication.

Will my answers be anonymous and confidential?

Your personal information (such as your name, address etc) is not required on any of the questionnaires and therefore they will be completely anonymous. The questionnaires will be seen by me and I will not have access to any information that could identify you at any time. The only other information I will receive is clinical information provided by your Consultant Cardiologist including whether you experienced anoxia or not, when your cardiac arrest occurred, how long you were unconscious etc, which again will be anonymous. This information and the questionnaires you complete will have a code which allows me to match them up. The only person who would be able to identify you from the code is the Consultant Cardiologist; however this will only be done if you give permission. Everything that will be collected will be anonymous and will be stored in locked filing cabinets at the University of Lincoln therefore no one else will be able to access it.

Could there be any disadvantages of taking part?

The questions in the questionnaires may ask you about things that are personal or that you find distressing. The intention of the research is not to upset you so if this was the case it would be important that you were supported. If after completing the questionnaires you had any concerns the advice would be to speak to your GP or alternatively you could contact Dr Patrick Vesey, a Consultant Psychologist who is aware of this research (0115 9249924). There are also other organisations that may be able to offer confidential support such as The Samaritans (08457 90 90 90).

What will happen to the results of the study?

The results of the study will be written up as part of my Doctoral thesis and reports will be written which I hope to be published in a peer reviewed journal. You will not be identified in any report or publication.

Will I find out the results of the study?

A summary of the results will be available for participants. If you would like to receive this please tick the appropriate box on the 'general information' sheet enclosed. I will then provide a list of codes of participants who want to receive the summary to the Consultant Cardiologist who will be able to find your details and send you a copy when this is available.

Who will be monitoring the research project?

A Research Ethics Committee reviews all research that is carried out in the NHS to ensure participants safety and rights are protected. This research project is also supervised by a university research tutor and a Consultant Clinical Psychologist working for Nottingham University Hospitals NHS Trust.

Who do I contact if I want more information about the research or advice about whether to take part?

(Details provided)

Appendix E Demographic information sheet

Code:

General details

Please provide the following information:

Age _____ **Gender** Male ☐
Female ☐

Living arrangements Living alone ☐
Living with partner / family ☐
Other _____

Employment status Full time employment ☐
Part time employment ☐
Unemployed ☐
Sick leave ☐
Other _____

Have you ever had any other medical diagnosis or illness that may affect your functioning? (E.g. stroke, brain injury, epilepsy, encephalitis, meningitis etc)

Yes ☐ No ☐ If yes, please state

Did you have any psychological difficulties before the cardiac arrest which required treatment such as medication or ongoing therapy?

Yes ☐ No ☐ If yes, please state

Did you receive any assistance when completing the questionnaires?

Yes ☐ No ☐
if yes, please state what assistance you received

I would like to receive a summary of the results of this study Yes ☐ ☐
No